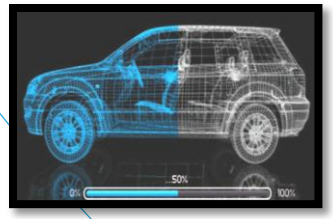
創新NFC應用新趨勢

Innovation Application for NFC

黃鐙誼
意法半導體
產品行銷經理



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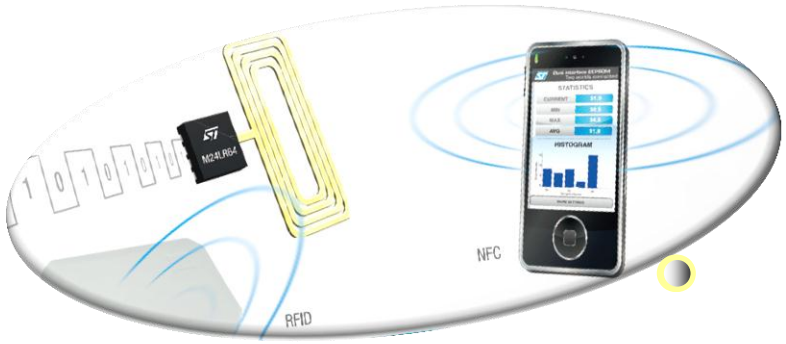
INNOVATION APPLICATION FOR NFC



- NFC/RFID is a key to IOT
- Dual interface EEPROM(M24LRXX) introduction
- M24LRXX product feature
- ST NFC for embedded reader and writer – CR95HF
- M24LRxx+ CR95HF application
- Enjoy the smart life and biz

NFC brief

- **Near field communication** (**NFC**) is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into close proximity, usually no more than a few centimetres.

- NFC builds upon **13.56MHz** Radio-frequency identification (RFID) systems by allowing two-way communication between endpoints.

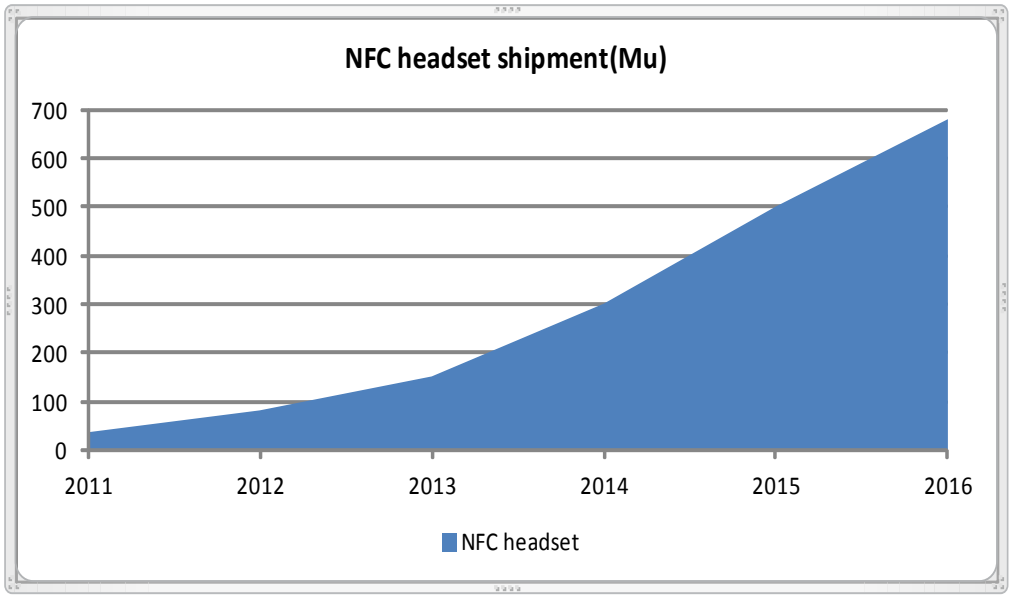
- The standards include ISO/IEC 18092[4] and those defined by the NFC Forum, which was founded in 2004 by Nokia, Philips and Sony, and now has more than 160 members.

- Comparison with BT:

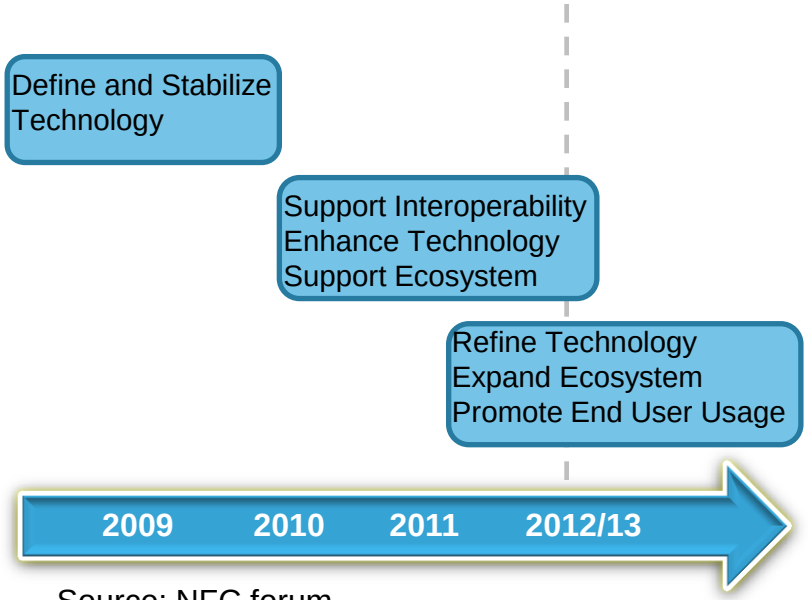
Source: WIKIPEDIA

Aspect	NFC	Bluetooth	Bluetooth Low Energy
Standardisation body	ISO/IEC	Bluetooth SIG	Bluetooth SIG
Standard	ISO 18092/13157 etc.	IEEE 802.15.1	IEEE 802.15.1
Range	< 0.2 m	~100 m (class 1)	~50 m
Frequency	13.56 MHz	2.4–2.5 GHz	2.4–2.5 GHz
Bit rate	424 kbit/s	2.1 Mbit/s	~1.0 Mbit/s
Set-up time	< 0.1 s	< 6 s	< 0.006 s
Power consumption	< 15mA (read)	varies with class	< 15 mA (transmit or receive

NFC-enabled handsets: booming market



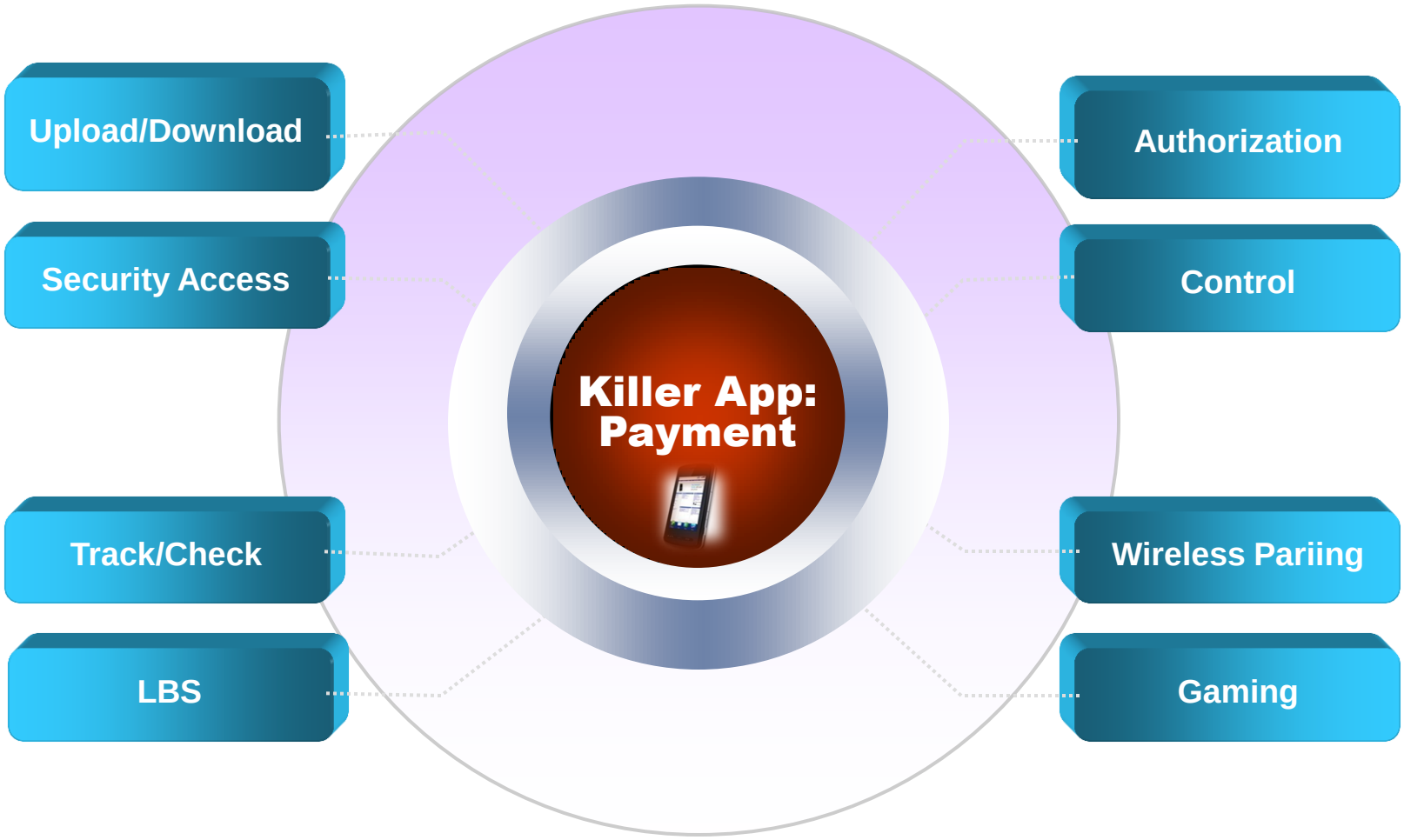
Source: IMS research



Source: NFC forum

- From 35Mp in 2011 up to 500 Mp in 2015
- Numerous NFC commercial models(over 45 phones) now available:
  - Android: over 22 phones;
  - Nokia: over 12 phones; Black berry: over 4 phones; others: over 7 phones
- Possible NFC architectures: NFC + SWP-SIM, NFC + embedded Secure element
- Mobile payment: new players (Google, Apple) strongly pushing for NFC introduction (cf Google wallet)

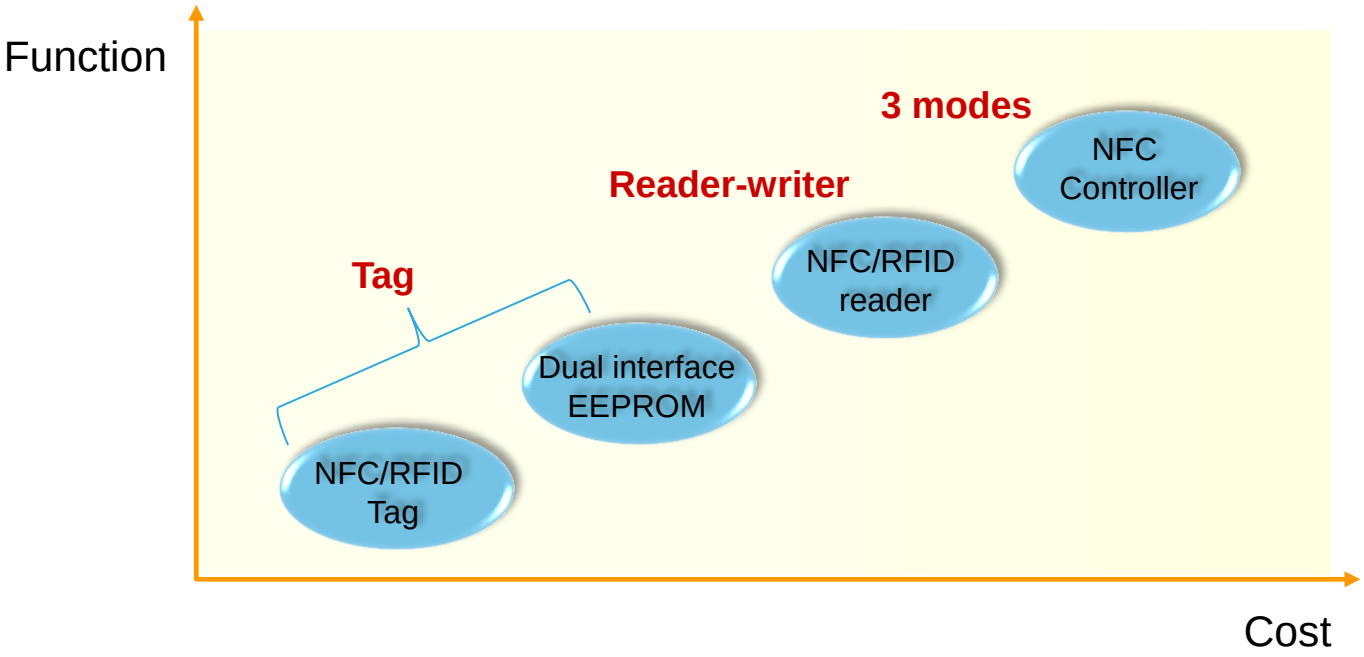
NFC: more than payment



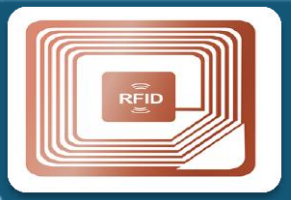
NFC mode

- 3 modes can be supported by NFC”:
  - Reader mode: Multi-protocols(ISO/IEC 14443, JIS X 6319-4/Felica, ISO/IEC 15693)
  - Pier-to-Pier mode: NFCIP-1. NFCIP-2(ISO/IEC 18092, ISO/IEC 21481)
  - Card emulation(Secure Element): EMVCo/ISO/IEC 14443, JIS X 6319-4/Felica)

Do you really need all of them(a reader-writer, lower data rate P2P, payment) at one?



ST's overall NFC/RFID Portfolio



NFC/RFID Tags

LR product line

- ISO15693 RF interface
- 1-Kbit to 64-Kbit

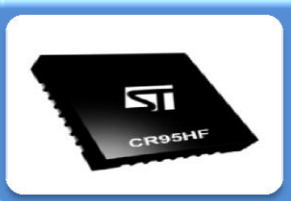
NFC for Objects or place identification

NFC/RFID tag with serial interface

M24LR product line

- ISO15693 RF interface
- Serial interface, Energy Harvesting (M24LR)

NFC for accessories and consumer electronics



NFC/RFID reader-writer

CR95HF

- Reader-Writer mode, supporting NFC tags type 1-4 and ISO15693
- SPI-UART unterface

NFC for embedded reader-writer

NFC Transceiver

STRFNFCA

- Reader/Writer, Card emulation & P2P NFC compliant
- Mifare reader management (combined with ST secure microcontroller)

Secure NFC for non-mobile applications

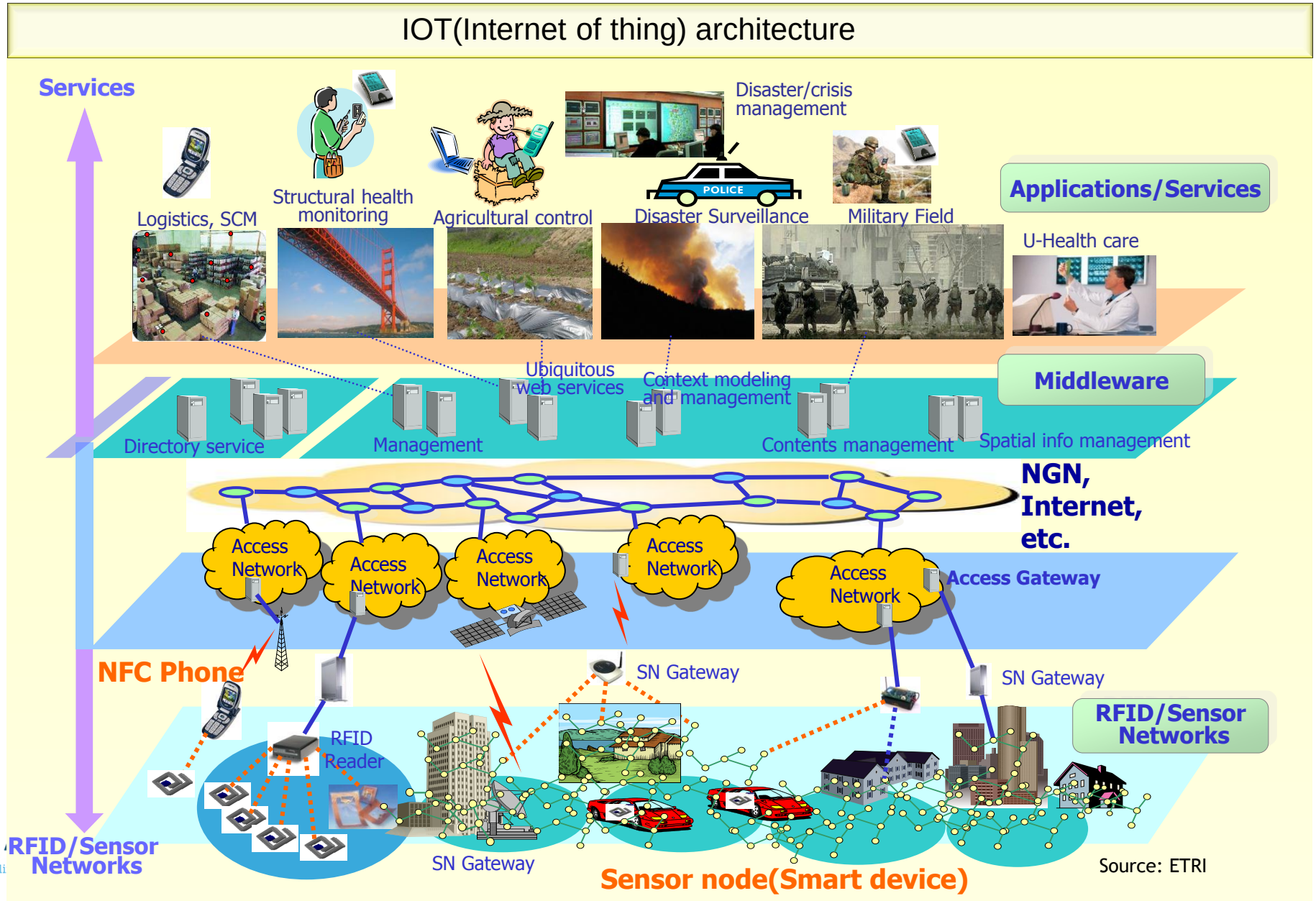
NFC Controller

ST21NFCA – ST21NFCB

- Reader/Writer, Card emulation & P2P NFC compliant
- Android "Ice Cream Sandwich" & WIN8 compatible

Secure NFC for mobile applications

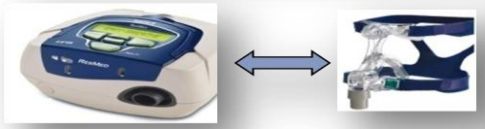
NFC/RFID is a Key to IOT



RFID Tag on IOT Application

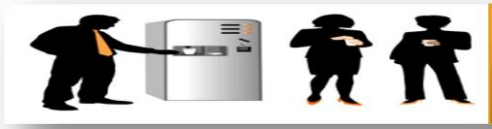
Mass Transit

RFID Tickets to access multiple Mass Transit means



Brand Protection

RFID tags to protect your innovation



ePurse & Access

RFID tags for micro-payments and security

Maintenance, Repair & Operations

Maintenance & Metrology Records, Settings, storage, … etc

Health Care

Calibration Records, Usage Historic, Large inventories…

Laundry

Global Cycle time reduction
Automated identification
Rapid & automated sorting…

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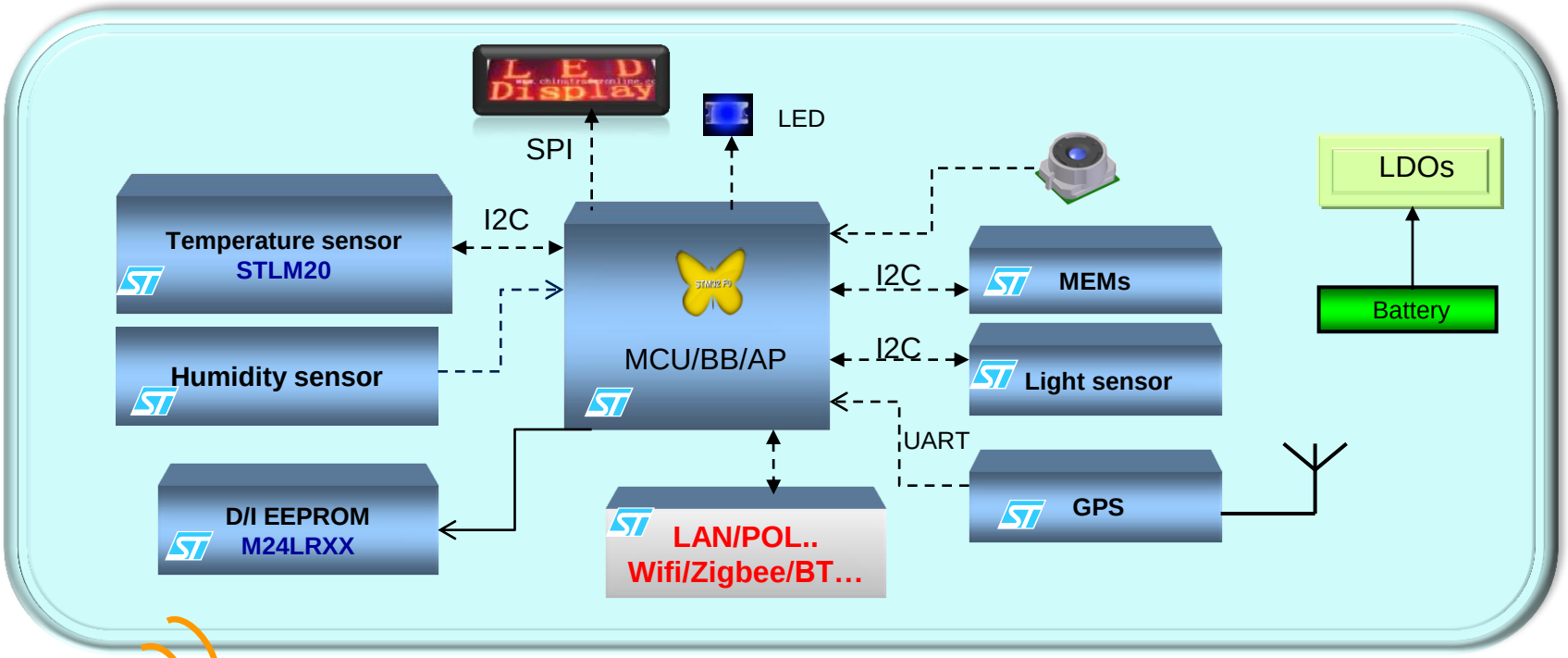
Smart Device(Sensor Node) for IOT

Smart Grid | Smart Applicances | Security | Automotive | Medical | Cold Chain /Logistics



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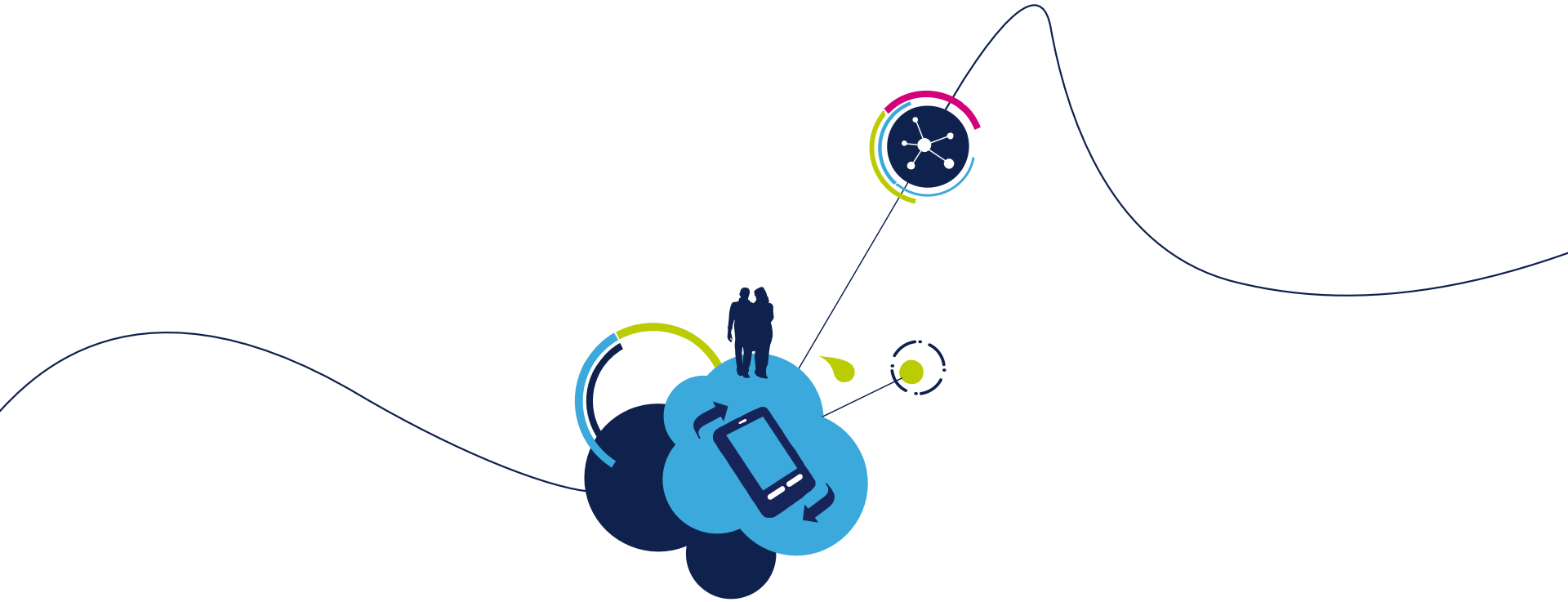

Dual Interface EEPROM Introduction

DualEE

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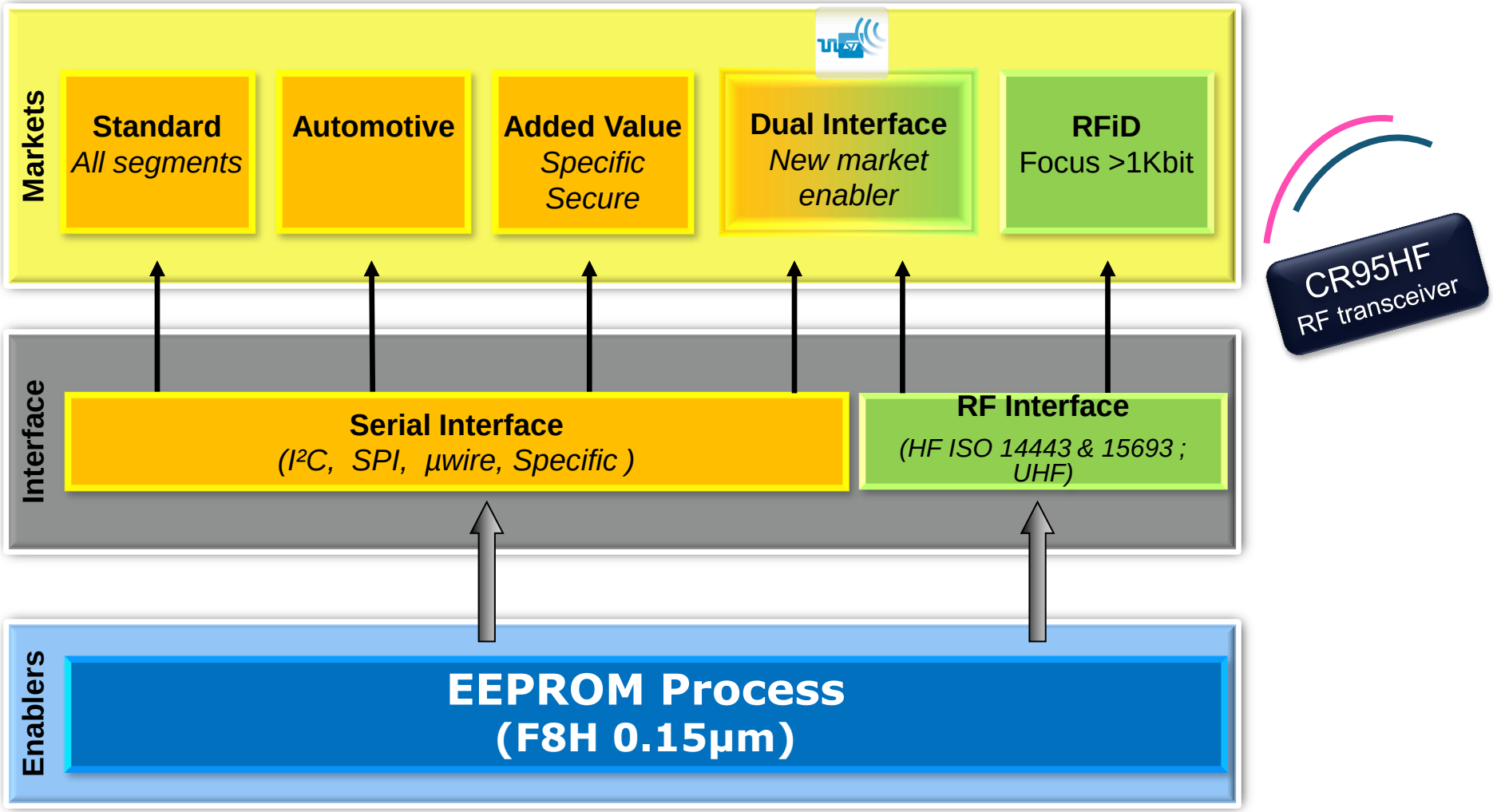
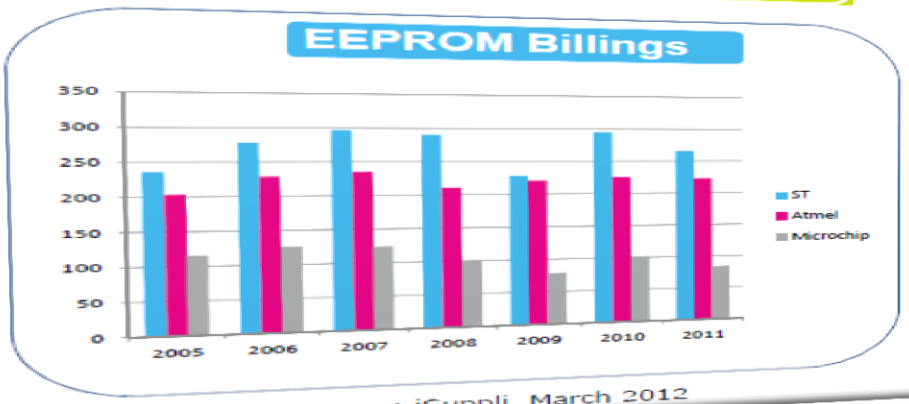
MMY : Strategic development axes



WW#1 EEPROM Supplier

#1 EEPROM Supplier



Source: iSuppli March 2012

ST has been supporting EEPROM for more than 20 years

- ST is a long term partner

ST has been number 1 EEPROM supplier for 7 years

- ST is a large scale & competitive supplier

ST keeps investing in advanced process for innovation

- ST is already using 0.15µm in mass production

ST Confidential

Broadrange Portfolio

	M24C01	M24C02	M24C04	M24C08	M24C16	M24C32	M24C64	M24128	M24256	M24512	M24M01	M24M02
SO8	•	•	•	•	•	•	•	•	•	•	•	•
TSSOP8	•	•	•	•	•	•	•	•	•	•	•	
MLP 2x3		•	•	•	•	•	•	•	•	•		
WLCSP				•	•		•	•	•	•	•	•*

		M95020	M95040	M95080	M95160	M95320	M95640	M95128	M95256	M95512	M95M01	M95M02
SO8	•	•	•	•	•	•	•	•	•	•	•	•
TSSOP8	•	•	•	•	•	•	•	•	•	•	•	
MLP 2x3		•	•	•	•	•	•	•	•	•		
WLCSP					•				•	•	•	•*

	M93C46	M93C56	M93C66	M93C76	M93C86
SO8	•	•	•	•	•
TSSOP8	•	•	•	•	•
MLP 2x3			•		

	M93S46	M93S56	M93S66
SO8	•	•	•

	M34E02
TSSOP8	•
MLP 2x3	•

NEW

Main features whatever package and density:
- 1.8V to 5.5V between -40°C and +85°C
- 1.7V to 5.5V between -20°C and 85°C
- 1.7V at -40°C available with new F8H

- I2C clock rate up to 1MHz with new F8H
- SPI clock rate up to 10MHz at 2.5V and 5MHz at 1.8V
- MW clock rate up to 2MHz

- * Under developpement
- PDIP package available for I²C 1Kb to 64Kb, and for MICROWIRE 1Kb
- M93S series feature programmable write protect

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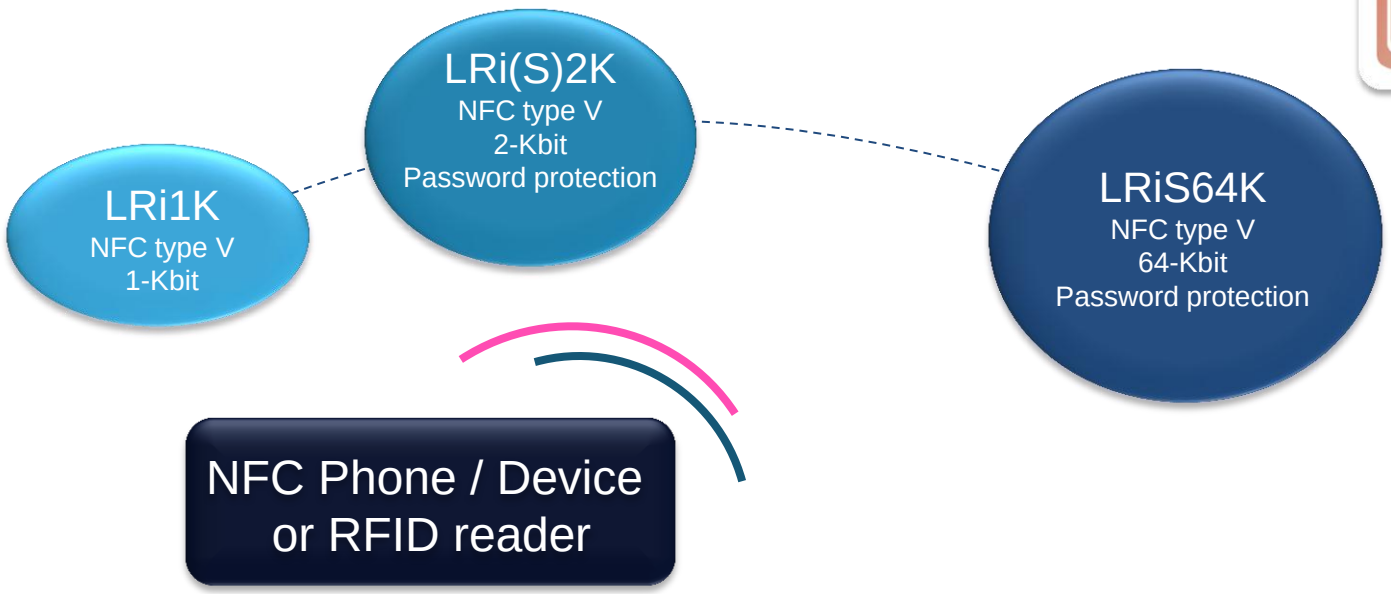
NFC / RFID tags



Benefits	Antenna size (type-V 4X smaller than other types)
RFID applications	Ski pass, Library tags, Asset tracking
NFC applications	Objects and places identification / wireless pairing

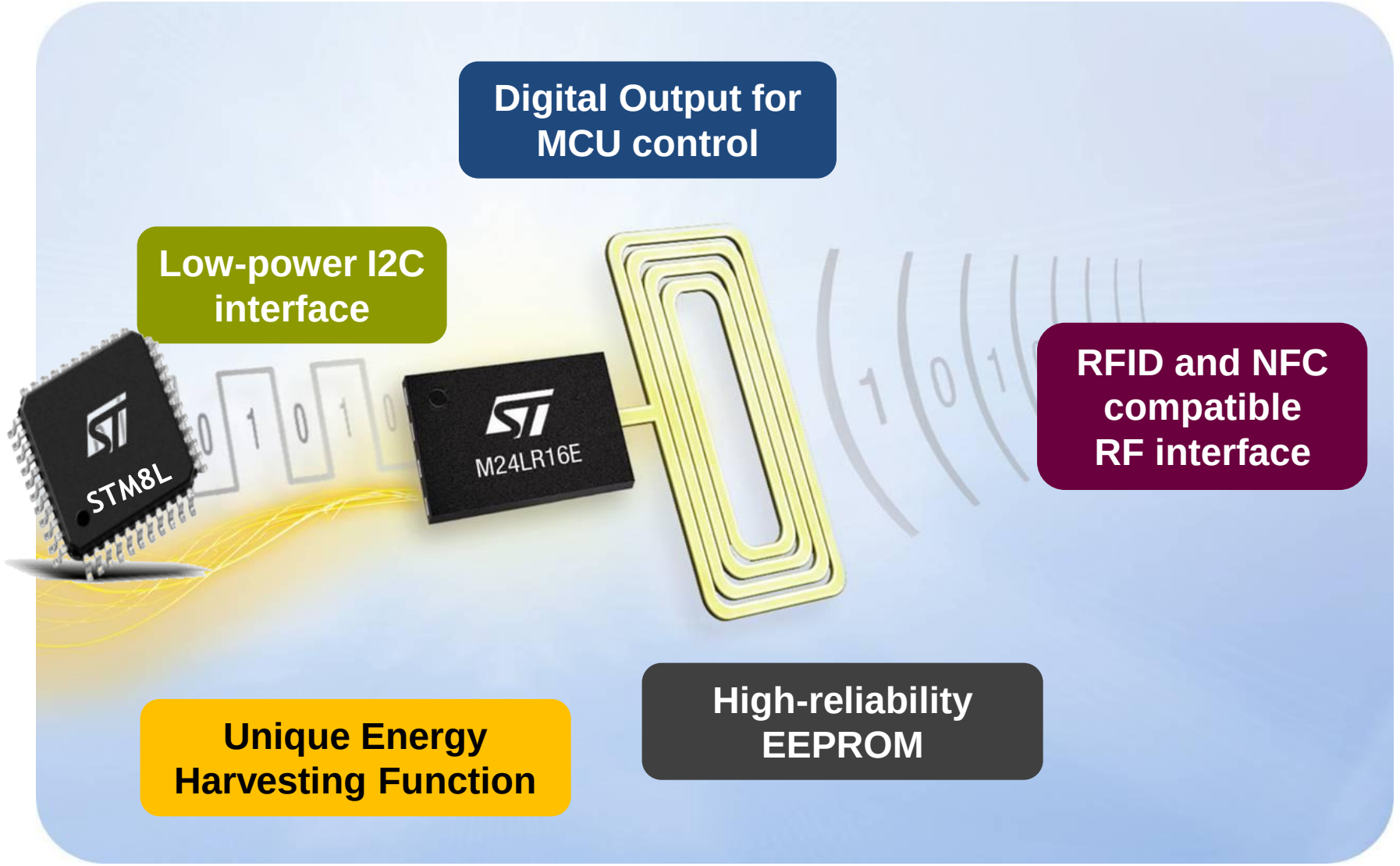
Dual Interface EEPROM - Concept

Read and write parameters

from *inside* (I²C) and *outside* (RF)

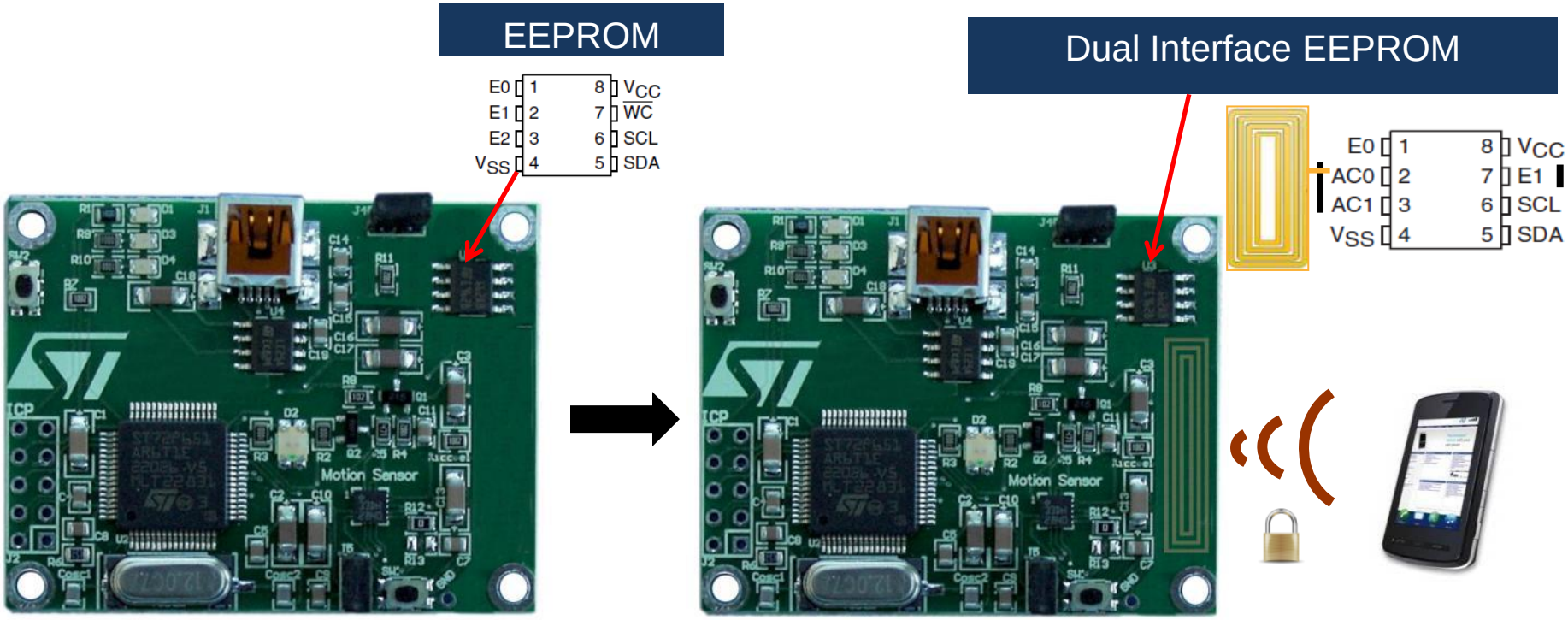
the application

Dual Interface EEPROM – Introduction



Dual Interface EEPROM - How it works

- Based on Passive RFID technology
  - Just add a 13.56 MHz inductive antenna onto your PCB



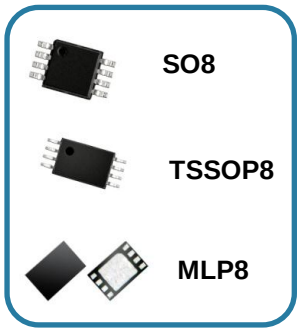
No battery needed to operate the dual interface EEPROM in RF mode

Accessible through a NFC phone

Dual Interface EEPROM - M24LR product line

- **Comprehensive portfolio**
  - Memory density: 4-Kbit, 16-Kbit and 64-Kbit
  - Large package choice

- **RF interface:**
  - Long range RFID
  - NFC (ISO15693)



M24LR04E
(4-Kbit)

M24LR16E
(16-Kbit)

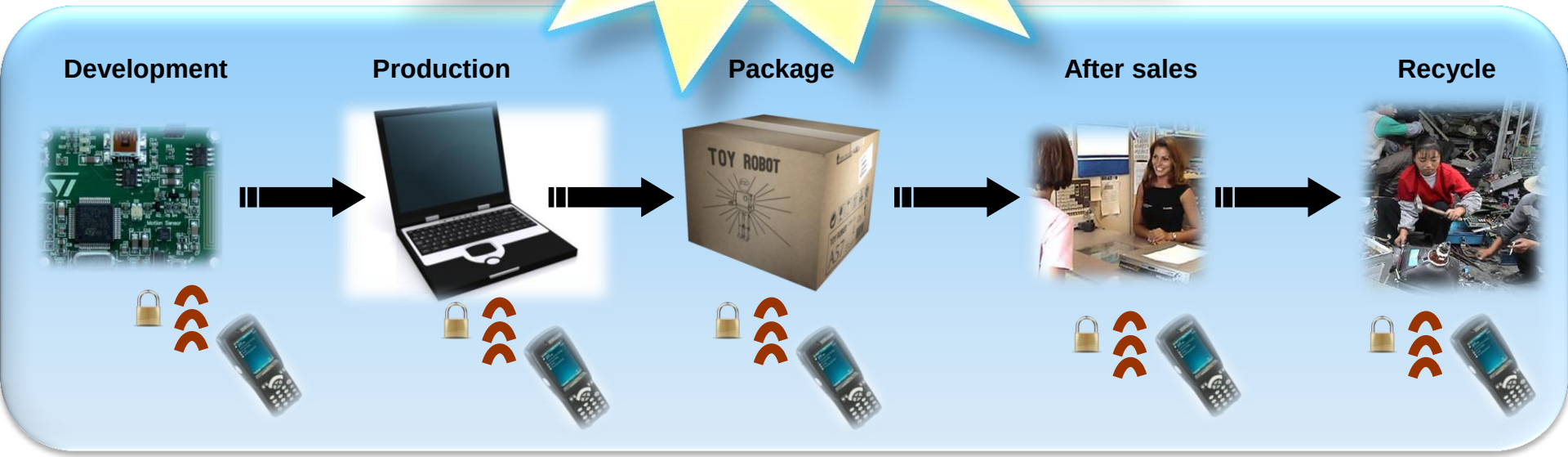
M24LR64E
(64-Kbit)

Serial Interface: low-power I2C

Energy Harvesting from RF

Enabling a wide rand of use cases…

Improve customer service and consumer experience for better company image!!



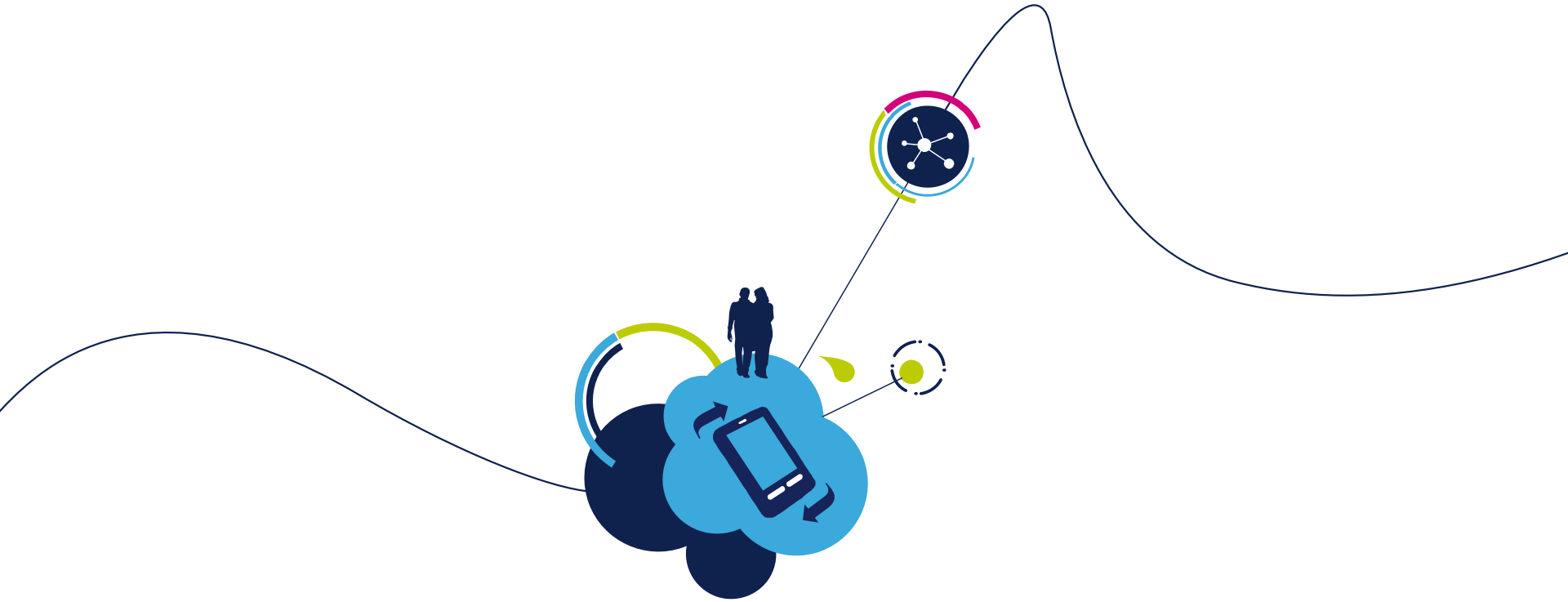
- No power wireless programming during design stage
- Multi-sets programming capability

- In-line calibration
- Improve the efficiency of production
- Identification /bar code application
- Traceability

- Better stock management thanks to outside box programming.
- Easy localization/ personalization
- Asset tracking

- No need for warranty card
- On-line technical support or FW/Parameter upgrade
- Event Log

- Asset tracking
- Event Log



Let’s see a video

DualEE

…in a wide range of applications

Consumer Electronics

Home Appliance

Peripherals

Token cards

Phone / tablet accessories

Electronic Shelf Labels

Dataloggers

Metering

Healthcare / wellness

Gaming

Dual Interface EEPROM…
Convenient zero-power RF data download

On-The-Go
Data Download

Pulse Oximeter

Thermometer

Pedometer

CPR card

M24LRxxE Inside

Glucose Meter

Hearing aid

Weight Scale

Fitness watch

Patient Monitoring

Ideal for portable devices such as healthcare and wellness products !

Home or Hospital
Data Analysis

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Possible to know how healthful you are

Magic mirror

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Dual Interface EEPROM… Augmented consumer experience

New innovative use cases for consumer and home appliance products !

Use smartphone for data processing and user-friendly interface

- User Manual's URL
- Usage / load information
- Power consumption history
- Warranty information
- Date of purchase
- User profile setting and reading
- Model ID
- Event recorder/temperature log
- Calibration data

Dual Interface EEPROM…
Augmented customer service

RF operations working even when device powered off !

Static information

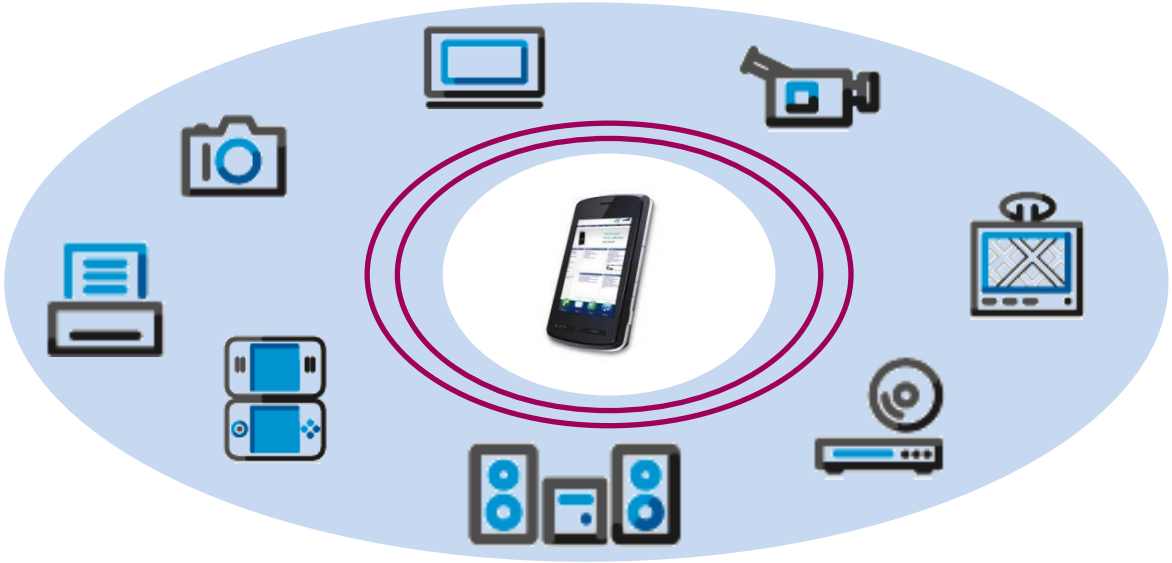
- Model ID
- Serial Number
- Manufacturing plant
- Date code
- BOM version
- Firmware version

Dynamic information

- Tamper detection information
- Incidents/defaults logs
- Tracking of critical components
- Last maintenance records

Dual Interface EEPROM
Convenient wireless pairing

- Integrate M24LR into your application
- Store network ID and password (Bluetooth, or Wifi) in M24LR memory
- Launch pairing App and Wave your phone close to the M24LR antenna
- The phone will simply read the network ID from the M24LR, then connect to Bluetooth or Wifi network without requiring any type-in from the user



NFC compliance required - ISO15693 NFC compliance expected March 2013

Dual Interface EEPROM… Enabling battery-less applications

RFID reader
or
NFC phone

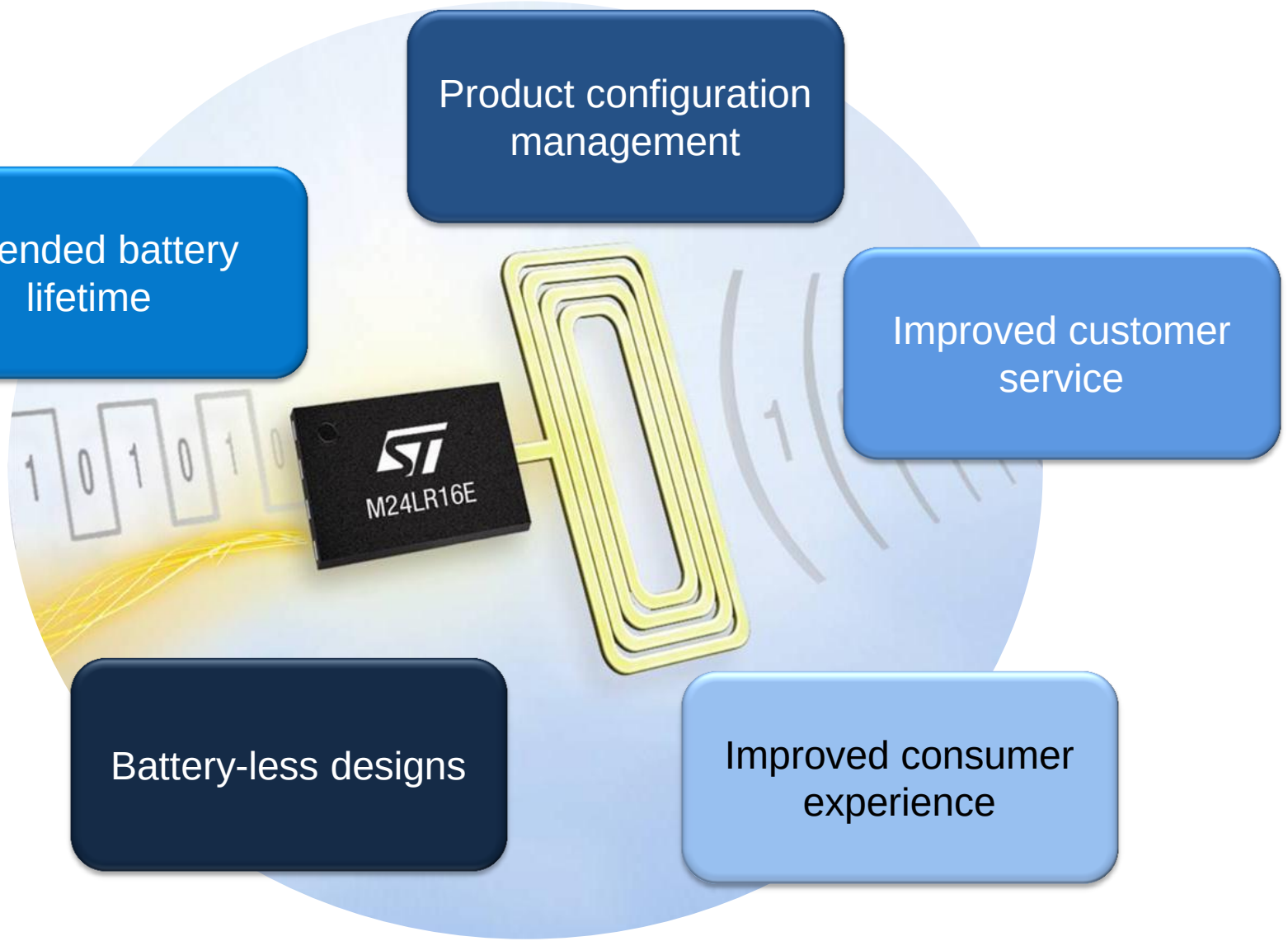
M24LRxxE

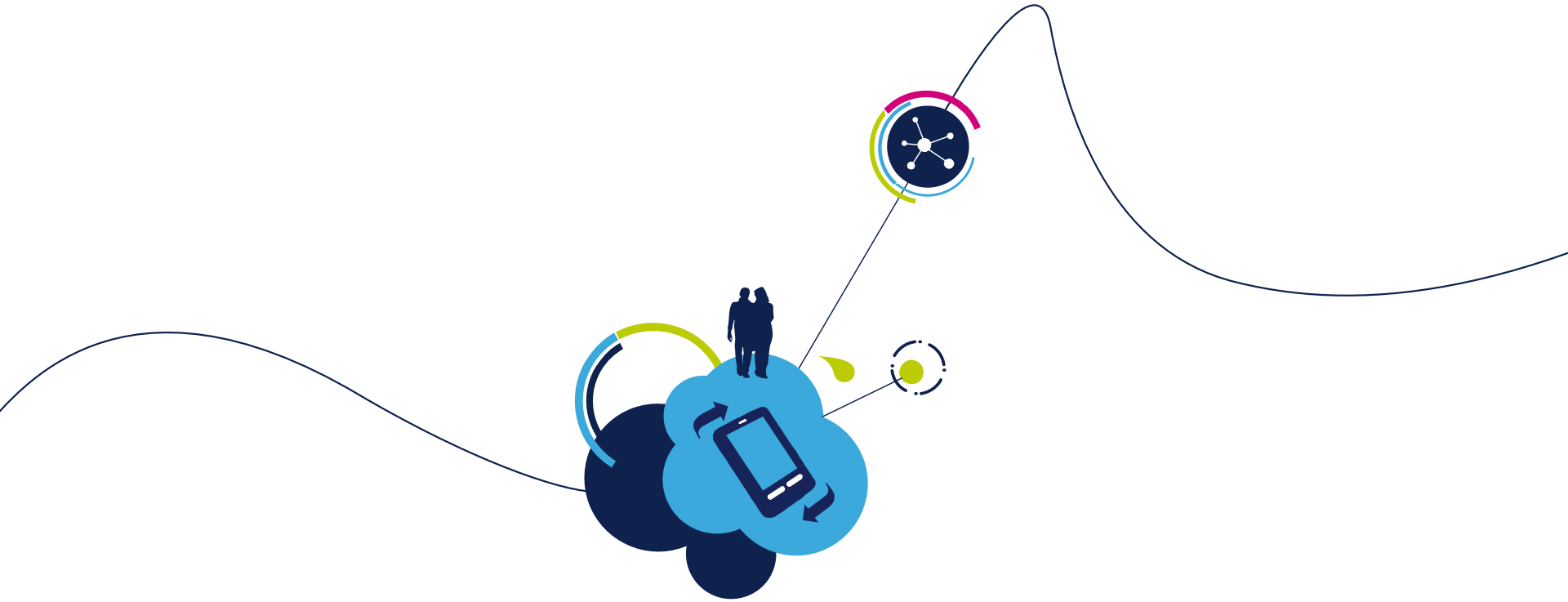
Vout

Innovative energy harvesting function
enabling battery-less designs !

A few mA at ~2V delivered to your MCU and other components

Dual Interface EEPROM - benefits





M24LRXX Product Features

DualEE

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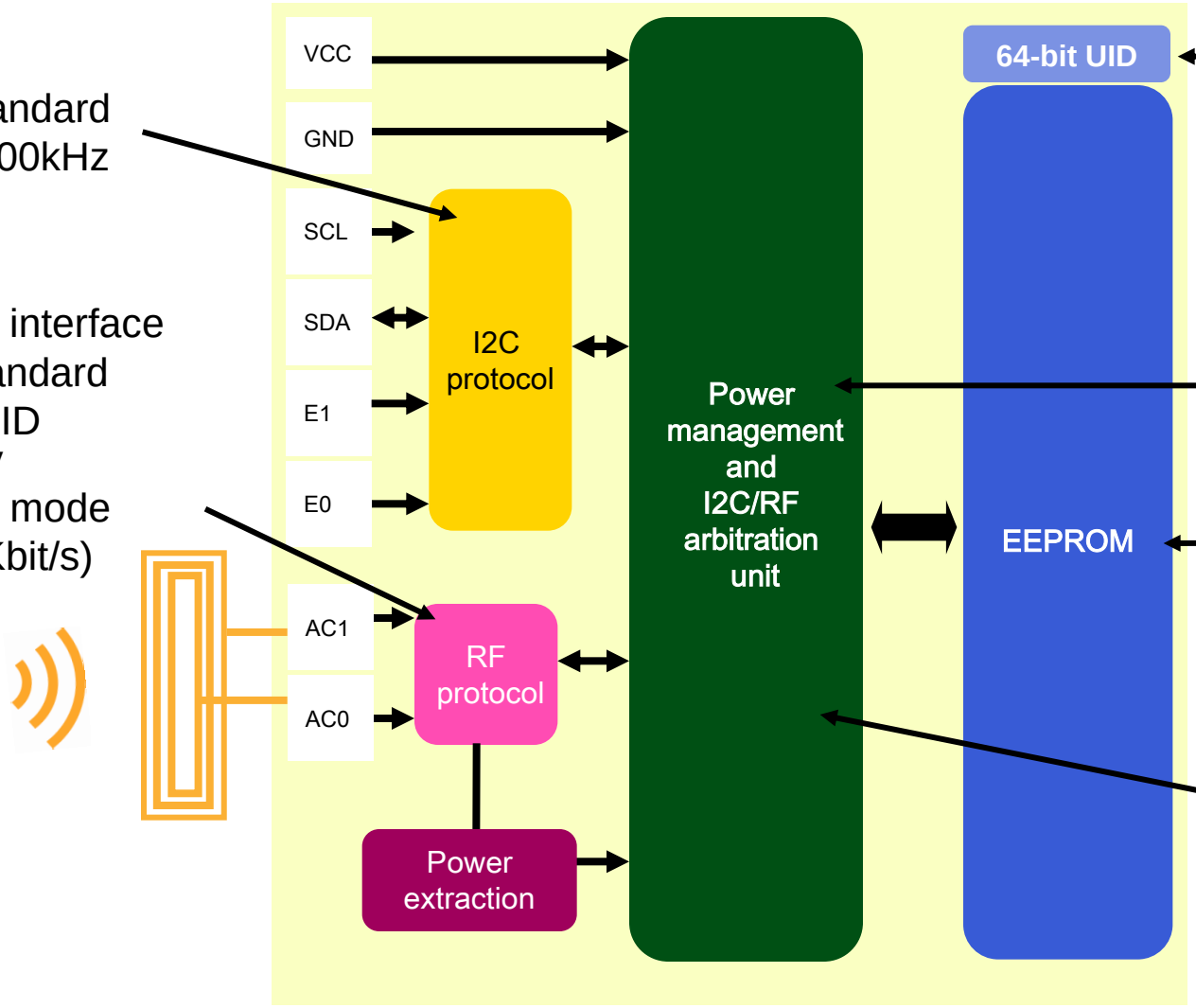
M24LR64 block diagram

I²C interface
- industry standard
- 1.8-5.5V, 400kHz

ISO 15693 RF interface
- industry standard
- passive RFID technology
- high-speed mode (up to 53 Kbit/s)



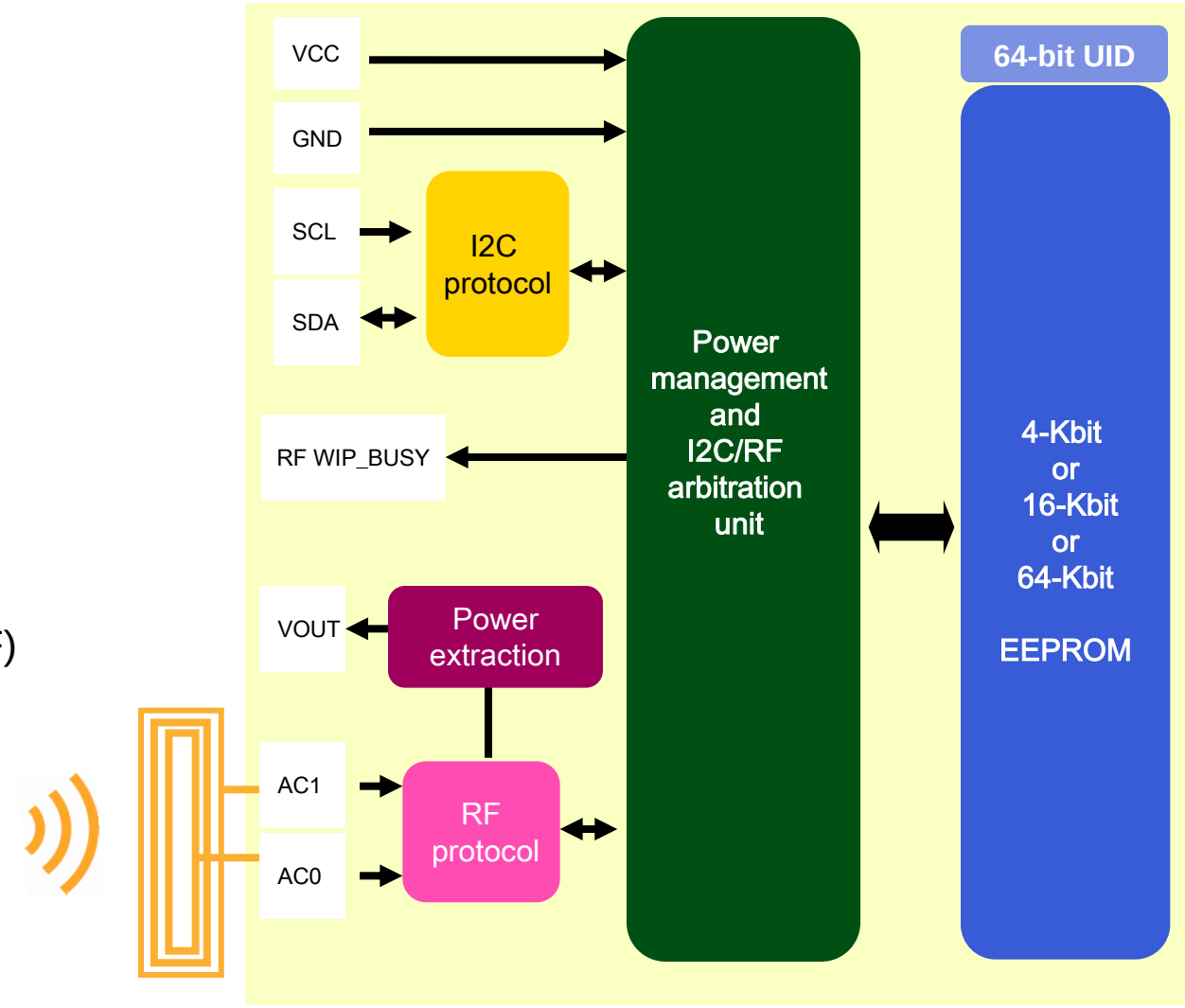
M24LR04E, M24LR16E, M24LR64E block diagram

I²C interface
(1.8-5.5V, 400kHz)

RF WIP_BUSY
(Digital output)

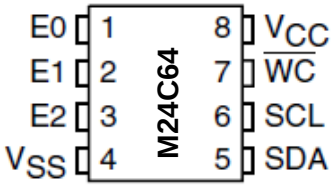
Vout
(energy harvesting from RF)

ISO 15693
RF interface



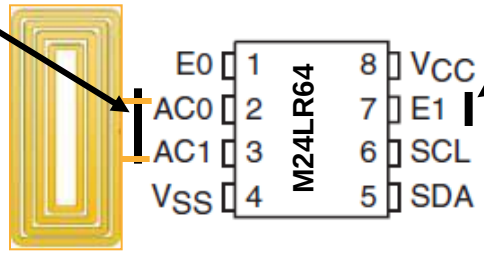
Serial EEPROM ⇔ Dual Interface EEPROM
Pinout considerations

M24C64
(standard serial EEPROM)



M24LR64 Antenna connection pins replacing M24C64 E1 E2 pins

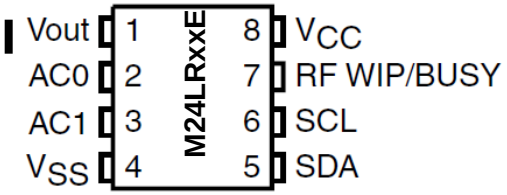
M24LR64 E1 pin replacing M24C64 /WC pin



M24LR64
(dual interface EEPROM)

M24LRxxE Vout pin replacing E0 pin

M24LRxxE RF WIP/BUSY pin replacing E1



M24LRxxE
(Energy harvesting dual interface EEPROM)

13.56MHz ISO15693 radio

13.56MHz ISM frequency band
(Industrial, Scientific, Medical)

No interference with
cell phones, bluetooth, wifi, zigbee, …

Zero power radio (*)
(low data rate and « short » range)

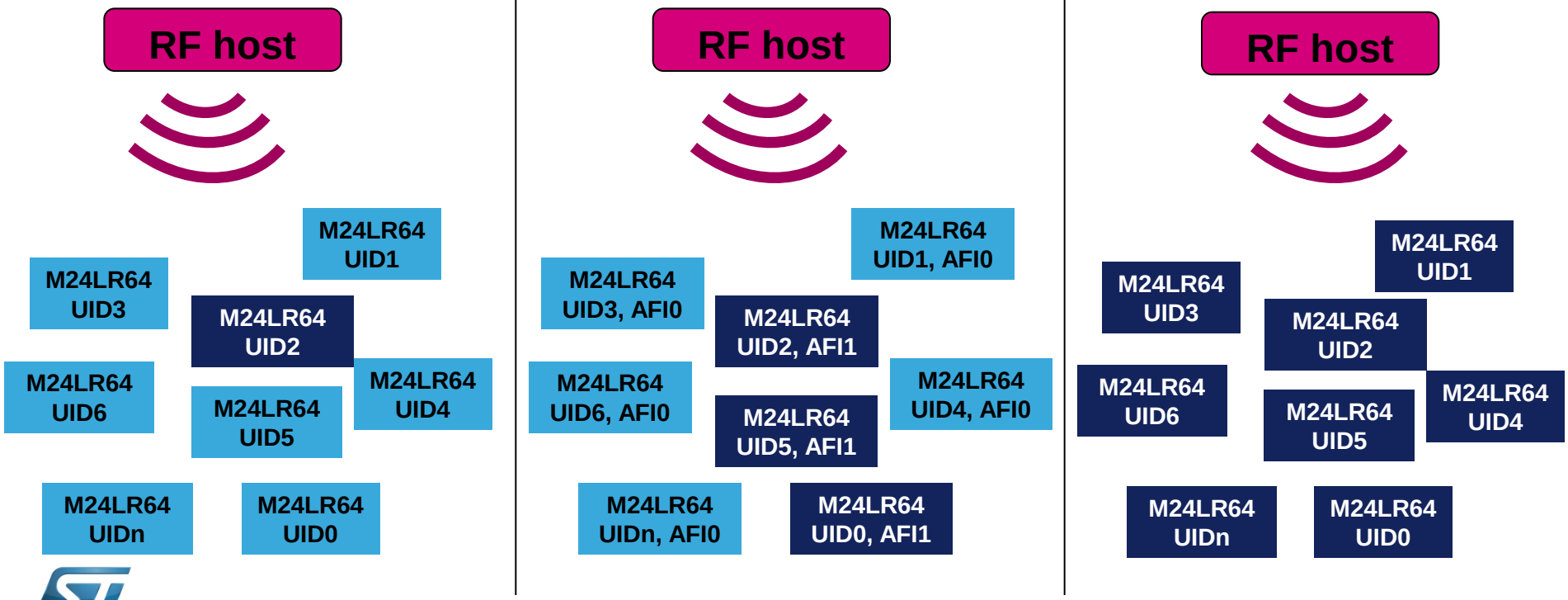
ISO15693 established
industry standard

RF host capable of identifying and communicating
with several M24LR64 in parallel

(*) energy provided by the RF host

Multi-device capable radio

- ISO15693 protocol enables to communicate with
  - One device among many (select UID)
  - Several devices among many (select AFI)
  - All devices among many All UIDs)



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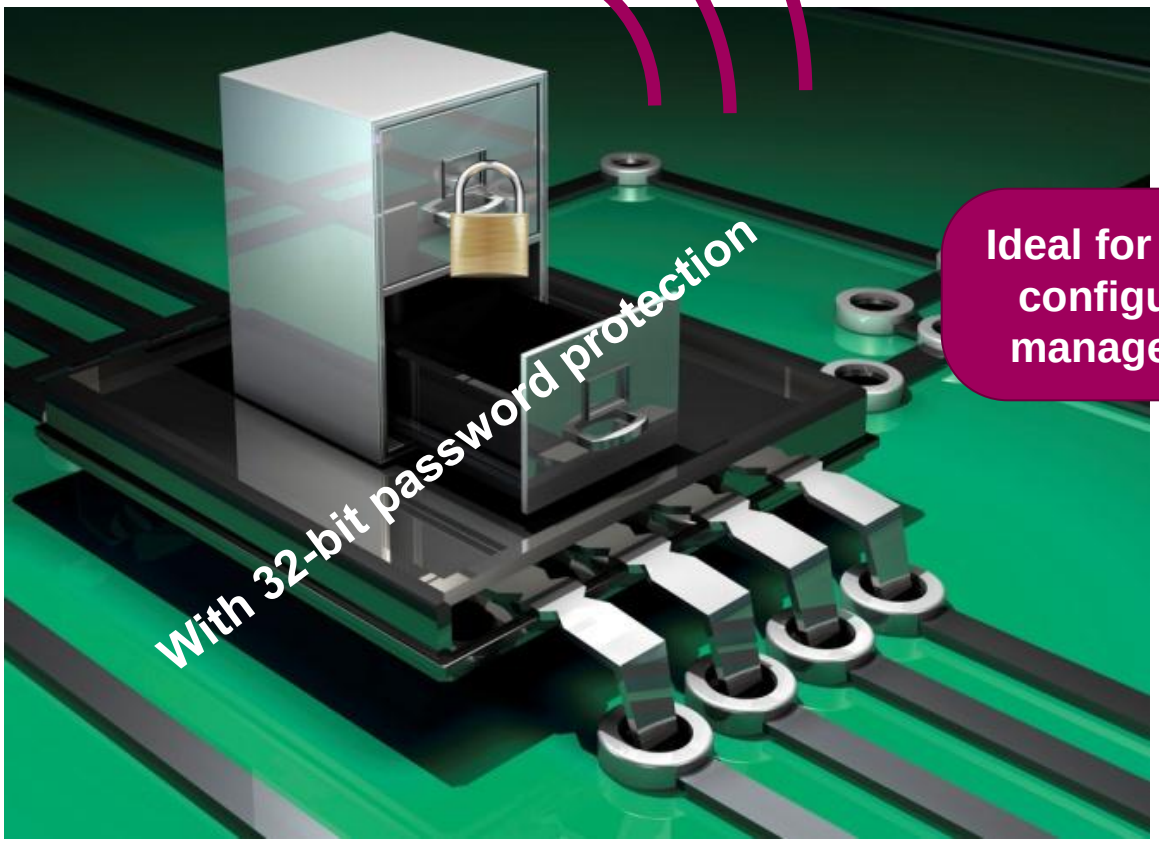
Dual Interface EEPROM…
New perspectives for parameters management

Wireless access

- Operating data
- User settings
- Traceability information
- Application data
- Event log
- Identification data

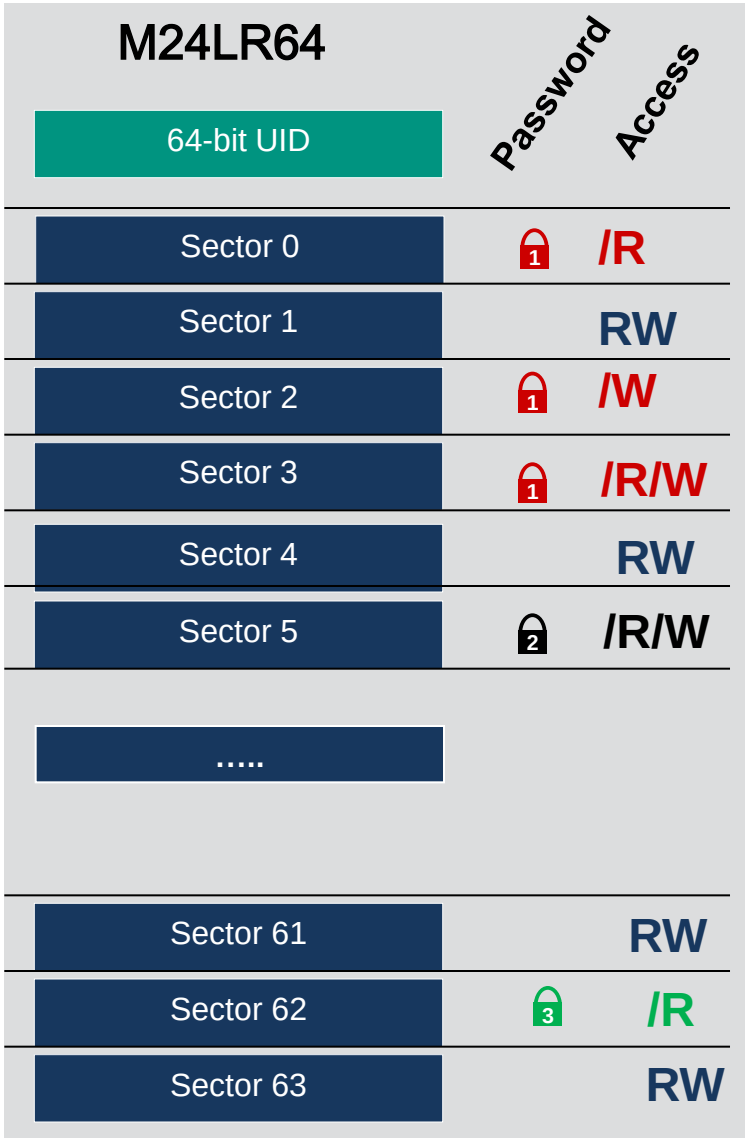


Ideal for product configuration management !

DualEE

Unique and flexible data protection scheme

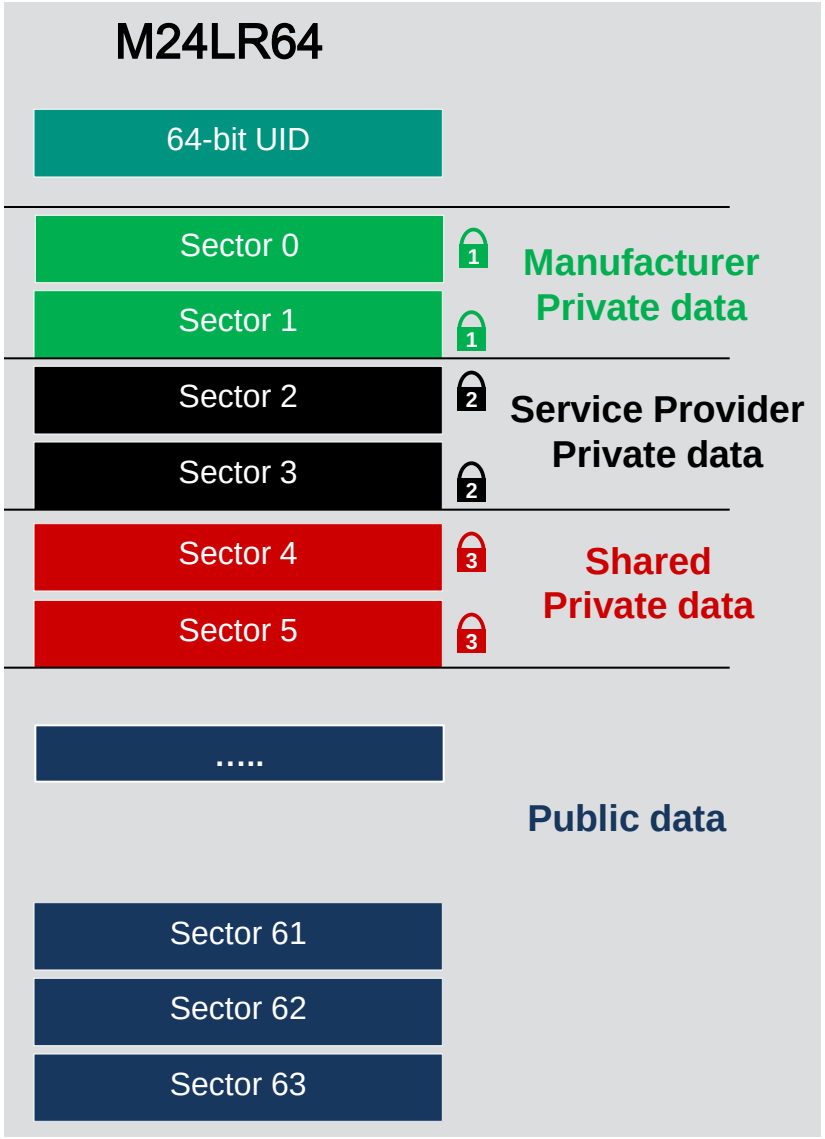
- 64-Kbit user memory
  - 64 independant sectors of 1-Kbit each
- RF access rights
  - Set of 3 x 32-bit passwords
  - Each sector can be protected by either one of the 3 passwords
  - Each sector can be protected in Write, Read or Write and Read access
- 32-bit password
  - 32-bit = more than 4 billion combinations



Also see application AN3002

The benefits of 3 passwords

- Ideal for multi-user
  - One key for user1 (e.g. Product Manufacturer)
  - One key for user2 (e.g. Service Provider)
  - One shared key for users 1 and 2
  - The rest is « public » data



Smart data protection – some hints

Create a unique password for each M24LR64 produced

- Each M24LR64 comes with a Unique 64-bit IDentifier (UID)
  - Factory programmed and locked by ST
- 64-bit UID can be used to compute a password different for each M24LR64 produced!

MyPassword = MyFunction (UID)

UID = 00 01 02 03 04 05 06h
Pwd = 06 00 01 02 03 04 05h

UID = 70 71 72 73 74 75 76h
Pwd = 76 70 71 72 73 74 75h

UID = 70 71 72 73 74 75 76h
Pwd = 76 70 71 72 73 74 75h

- Tutorial example: MyFunction = Rotate Right One Byte

Also, use checksums, and or encrypt the memory content, …

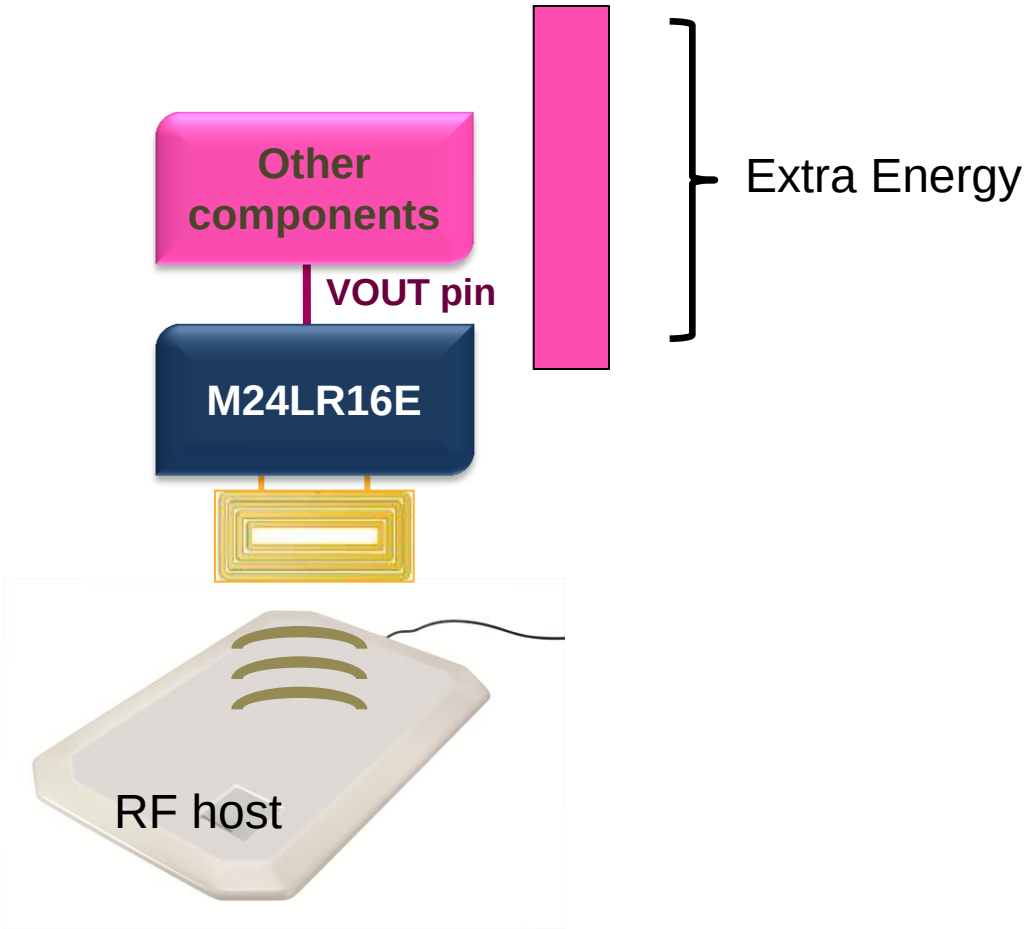
M24LRXX is also a low power I²C EEPROM

	M24C64 (serial)	M24LR64 (dual)
Icc operating write @2.5V	5 mA	0.4 mA
Icc operating read @2.5V	2 mA	0.2 mA

Great for event recorder !

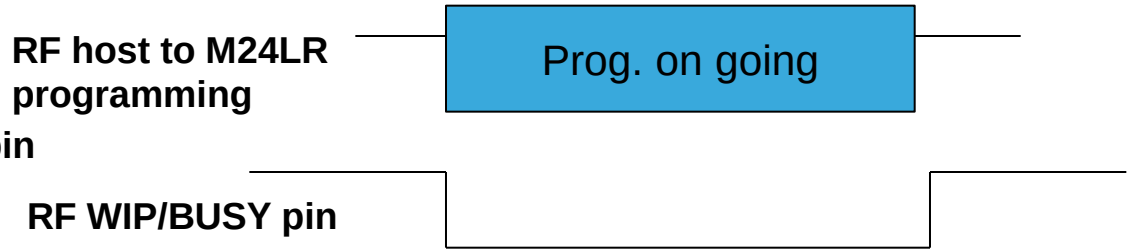
What is M24LR16E Energy Harvesting?

- When the Energy Harvesting function is ON, the M24LR16E can deliver the extra energy to other components



New RF WIP/BUSY digital output – Write In Progress

- When set for « RF Write In Progress », the RF WIP/BUSY pin toggles when the M24LR is being programmed by an RF host

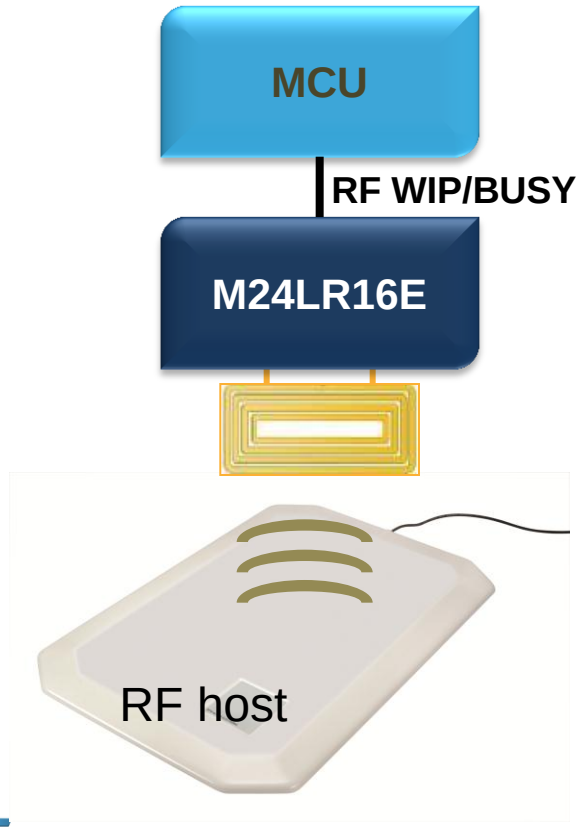


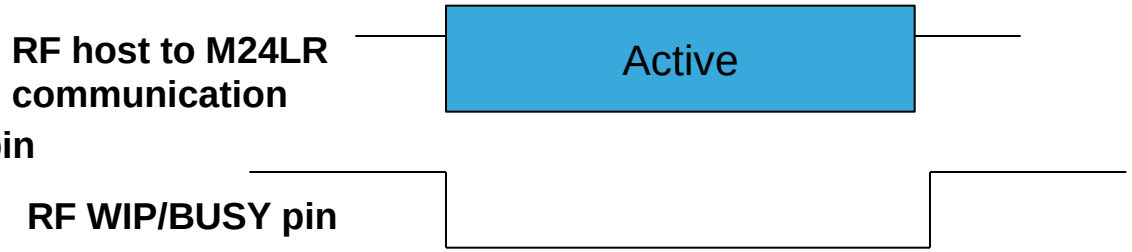
Benefits:

• Enables the MCU to know whether the content of the memory is being changed by the RF host

New RF WIP/BUSY digital output – RF port busy

- When set for « RF busy », the RF WIP/BUSY pin toggles during the execution of an RF command





Benefits:

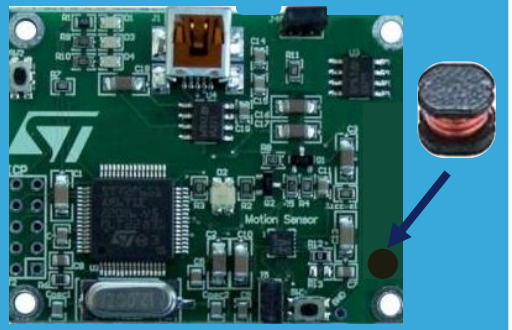
- Enables the MCU to know the RF host is attempting to communicate with M24LR
- Energy savings, no need to poll for I^2C ACK to know when the M24LR is ready to communicate

Antenna integration

On Board

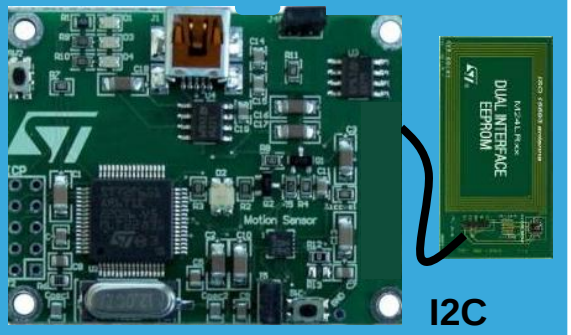
- **Pros**
- Integrated and compact solution
- **Cons**
- Probably less space available on the PCB for a large antenna. Read range may then be smaller

On-board inductor



- **Pros**
- Small footprint
- Standard component (4.7µH)
- Small design effort
- **Cons**
- Limited range
- Sensitive to reader-antenna orientation

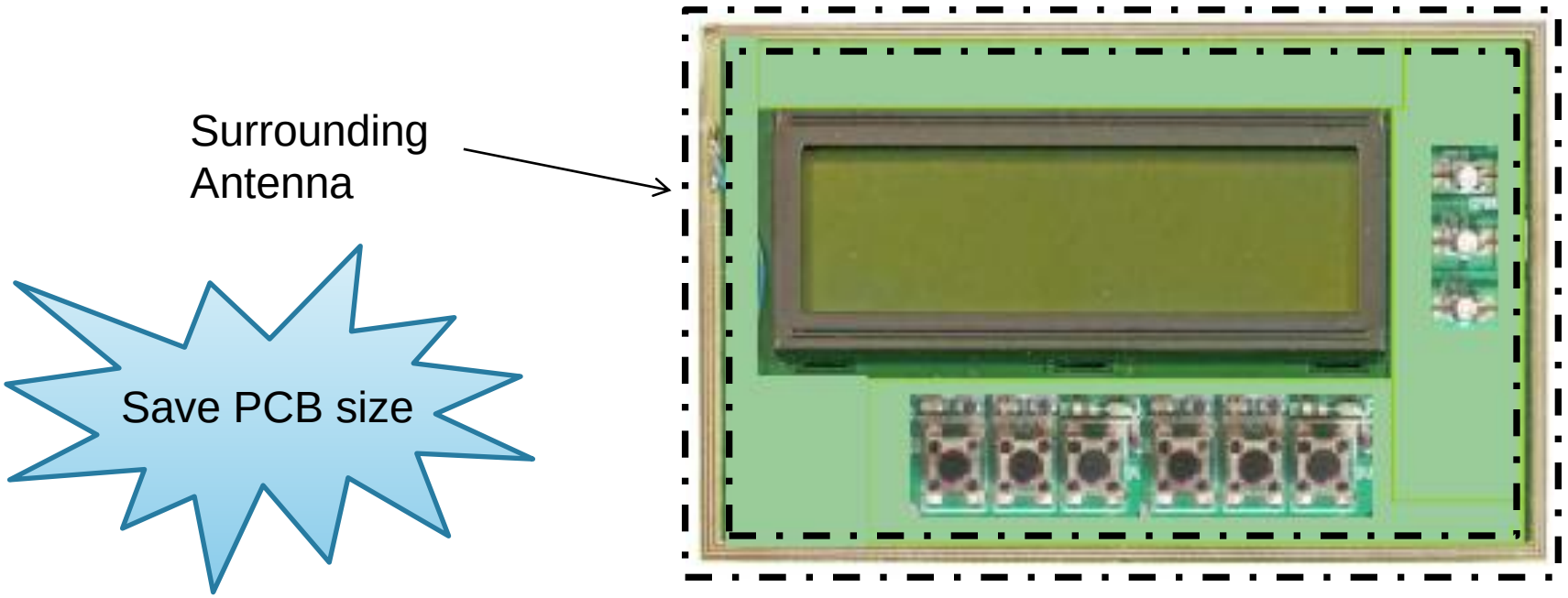
Off-board



- **Pros**
- Antenna closer to the outside
- Better range
- 2-layer PCB good enough
- **Cons**
- Until the antenna is connected, no RF communication possible

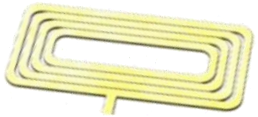
Designers support – antenna design

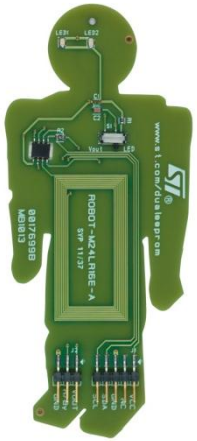
- There are other options for integrating the antenna into your PCB. An example is « surrounding antenna »
- Contact your ST technical support for specific antenna design support



Designers support - antenna integration

- ST provides documents helping customers design the antenna by themselves
  - Application note
    - AN2972 Designing an antenna for the M24LR64-R dual interface
    - AN3178 Using a surface-mount inductor as M24LR64-R antenna
  - Software
    - Executable meant for computing a 13.56 MHz antenna
  - Reference designs





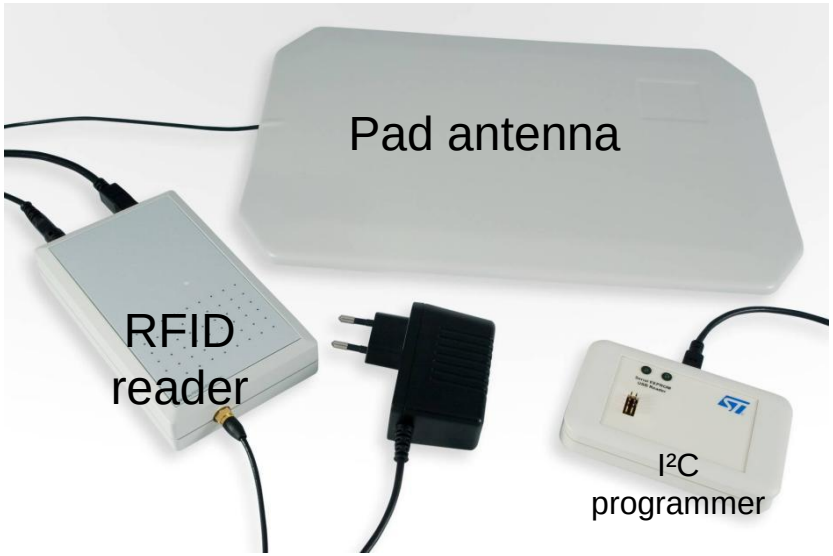
ROBOT-M24LR16E-A

ANT1-M24LR16E

ANT2-M24LR16E

ANTx-M24LR-A

Evaluation kits

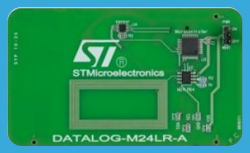


NB: SDK dll source files available for Windows for free. Charges apply for other platforms such as .Net, Java,…

All prices on this page are disty cost

M24LR64-R Datalogger reference designs

- Demonstrate the use of the M24LR64 in a data logging application (medical, industrial sensors, …) and helps customers get started with their design



DATALOG-M24LR-A
Temperature sensor

STEVAL-IPR002V1
Temperature, shock, vibration, light, humlidity sensor

DualEE

Dataloggerv3

NFC Android Apps

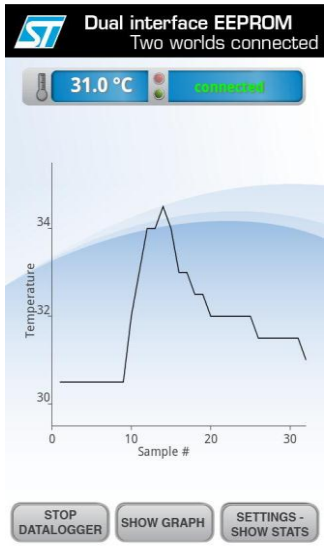
PC demonstration software

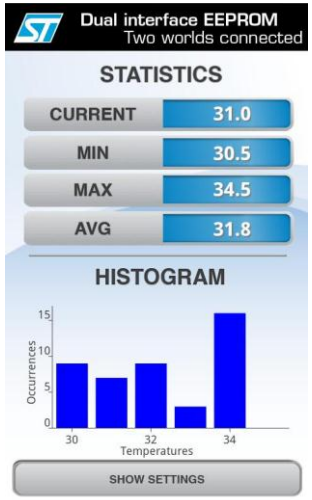
Supporting material

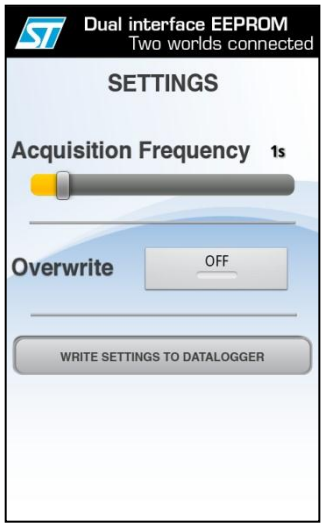
App note AN3209
User Manual UM0925
MCU firmware code
Board gerber files
NFC Android App code

The M24LR64-R Datalogger supporting material can be downloaded at www.st.com/dualeeprom

Dual EE NFC Android App







Works with DATALOG-M24LR-A reference design

DualEE

- Dual EE app on the Android market
- Source code at www.st.com/dualeeprom

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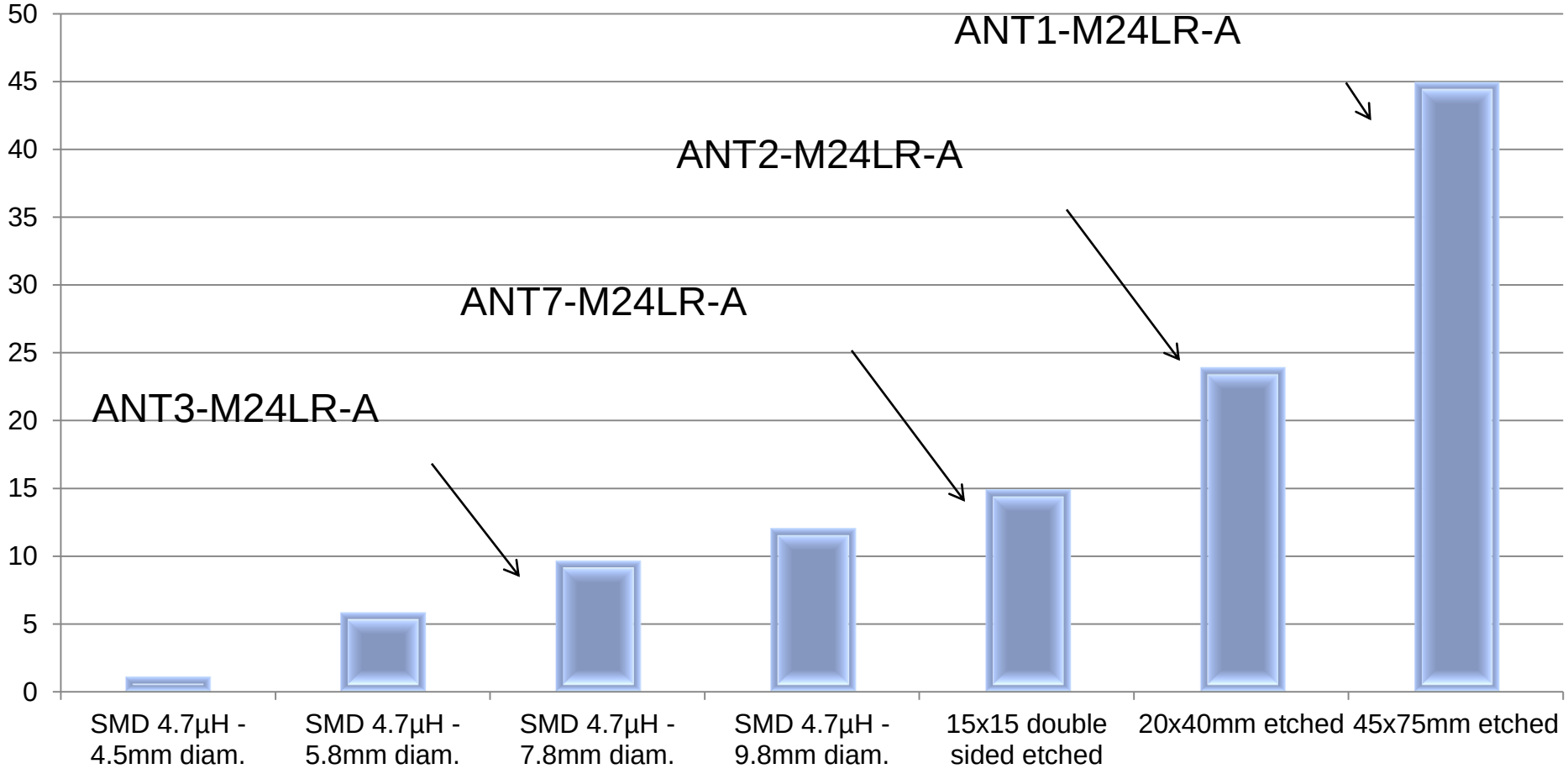
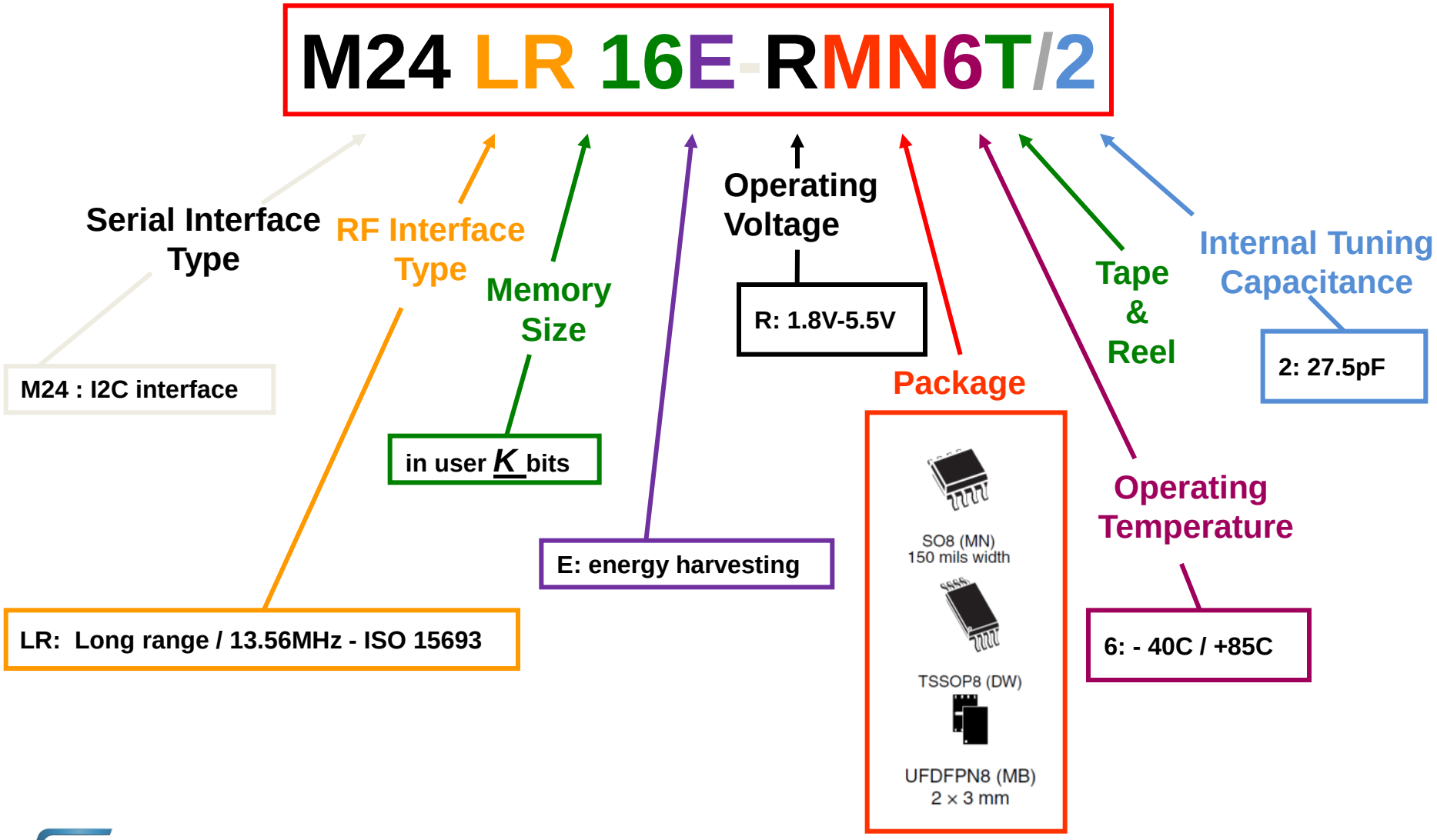
Read range (cm) versus antenna type

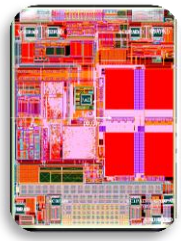


Measurements with Feig MR101 pad antenna reader in free air

Dual Interface EEPROM
Nomenclature for package delivery



Dual Interface EEPROM
Nomenclature for die delivery



M24 LR 64-RS185/2

Serial Interface Type

M24 : I2C interface

RF Interface Type

LR: Long range / 13.56MHz - ISO 15693

Memory Size

in user *K* bits

Operating Voltage

R: 1.8V-5.5V

Package

S/Z: Sawn wafer on metallic frame and UV tape (**inkless/inked**)

1: wafer orientation in frame

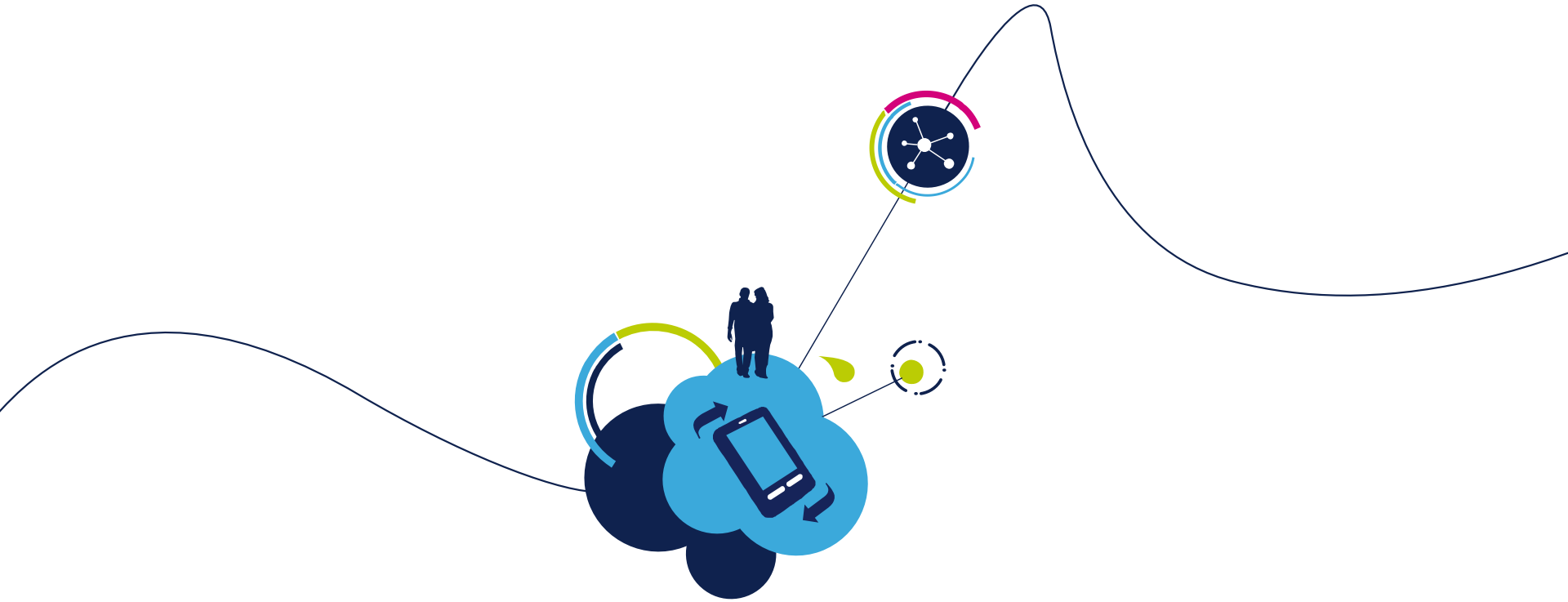
8: wafer size in inches

5: wafer thickness = 140µm

Internal Tuning Capacitance

2: 27.5pF

- Ultra thin: 140µm thickness +/-10µm
- Production Minimum Ordering Quantity (MOQ) is 5 wafers, i.e. approximately 42.5ku



RF reader-writers

4 types of RF reader-writers

- Commercial ISO15693 RFID reader-writers, available through partners

- ST’s 13.56MHz transceiver IC for embedded RF reader-writer

- Mobile phones with ISO15693 capable NFC function

- ST’s evaluation and development kits

Commercial RF reader-writers

- ISO15693 standard at 13.56 MHz - Firmware upgrade might be required
- Exists in various form factors providing wide range of price and performance

Handheld reader

RFID reader

Pad antenna

Tunnel station

Conveyor tunnel reader

Gate antenna

Paddle reader

Check out the video at www/st/com/edemoroom
(Play « Dual Interface EEPROM RF technology »)

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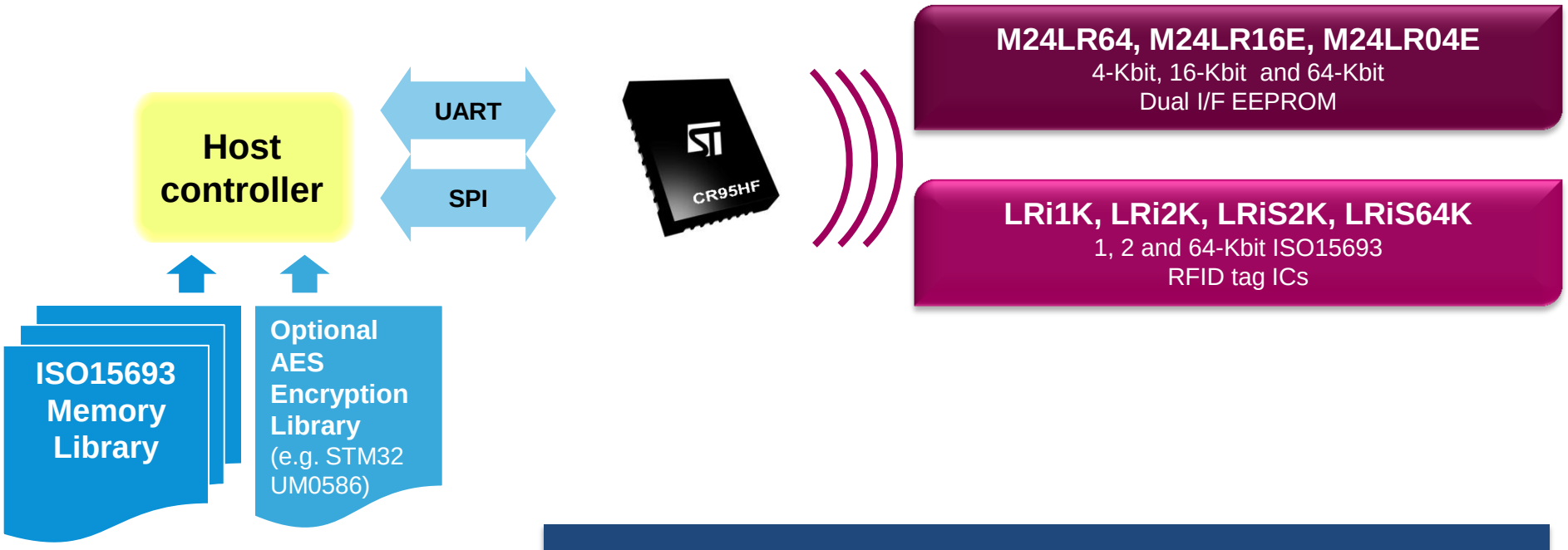
Embedded reader-writer: CR95HF chip

- Full support of ST ISO15693 products with CR95HF
  - Software libraries
  - Reference design
  - Application notes



Design your own embedded RF reader-writer

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DEMO-CR95HF-A support

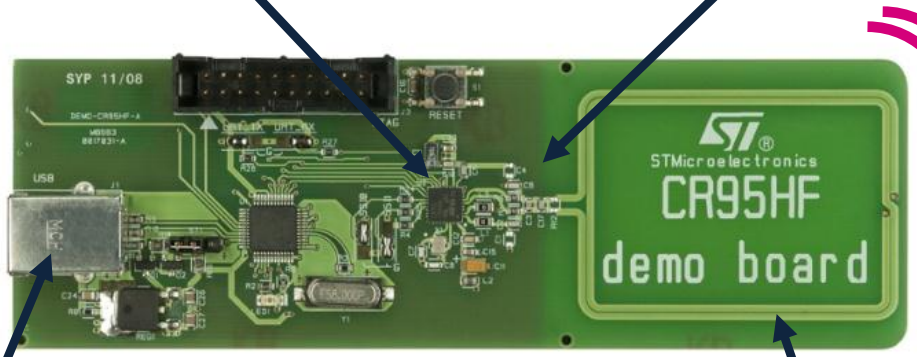
- Ideal for demonstrations and performance assessment
- Directly plugs on your computer (USB), comes with PC software

CR95HF drivers (ANSI C)
- Source code CR95HF drivers.rar
- Application note AN3355

Schematics and gerber files
- Schematics (0017031-B-SCM.pdf)
- Gerber files (0017031-B-Gerber.zip)

Host system

USB

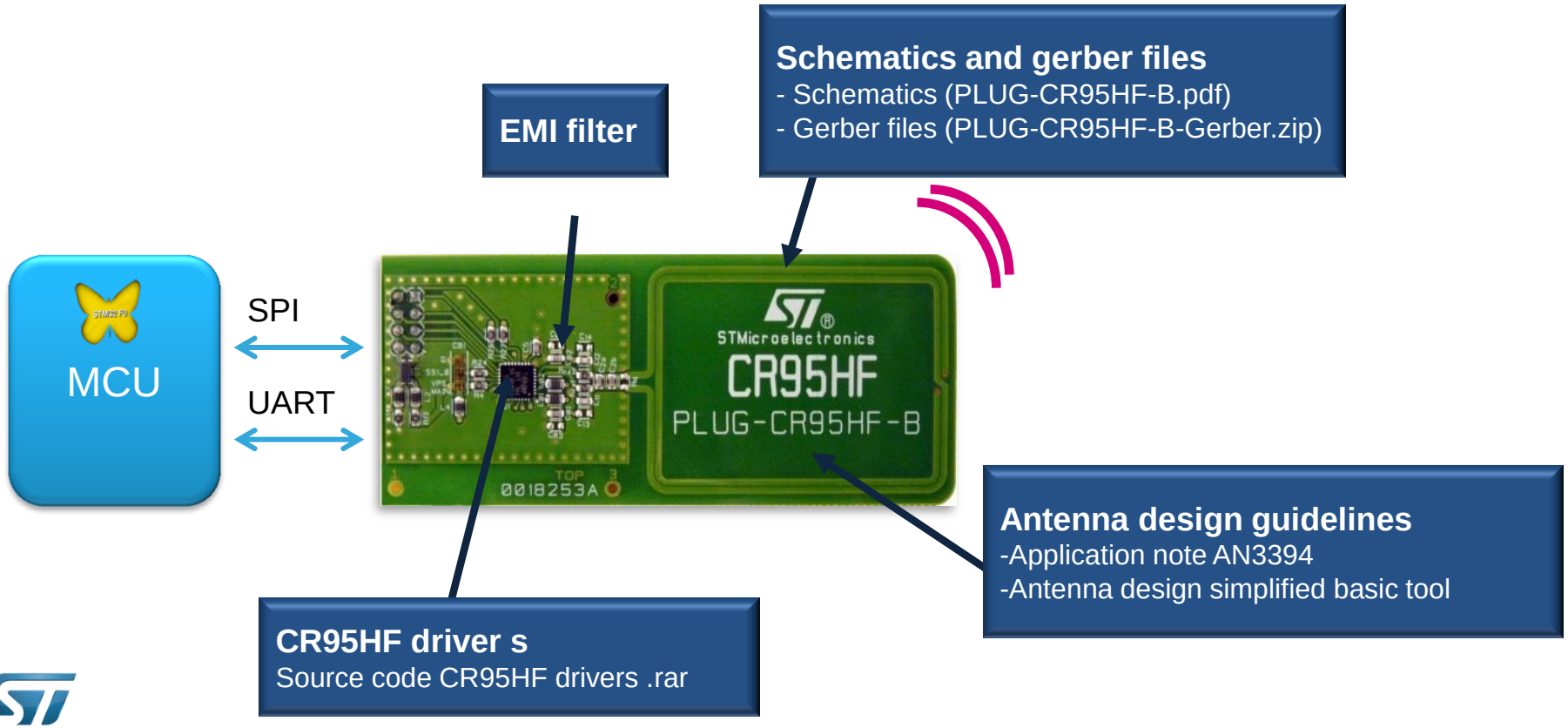


PC demonstration software
- M24LRxx Application Software 2.0.zip

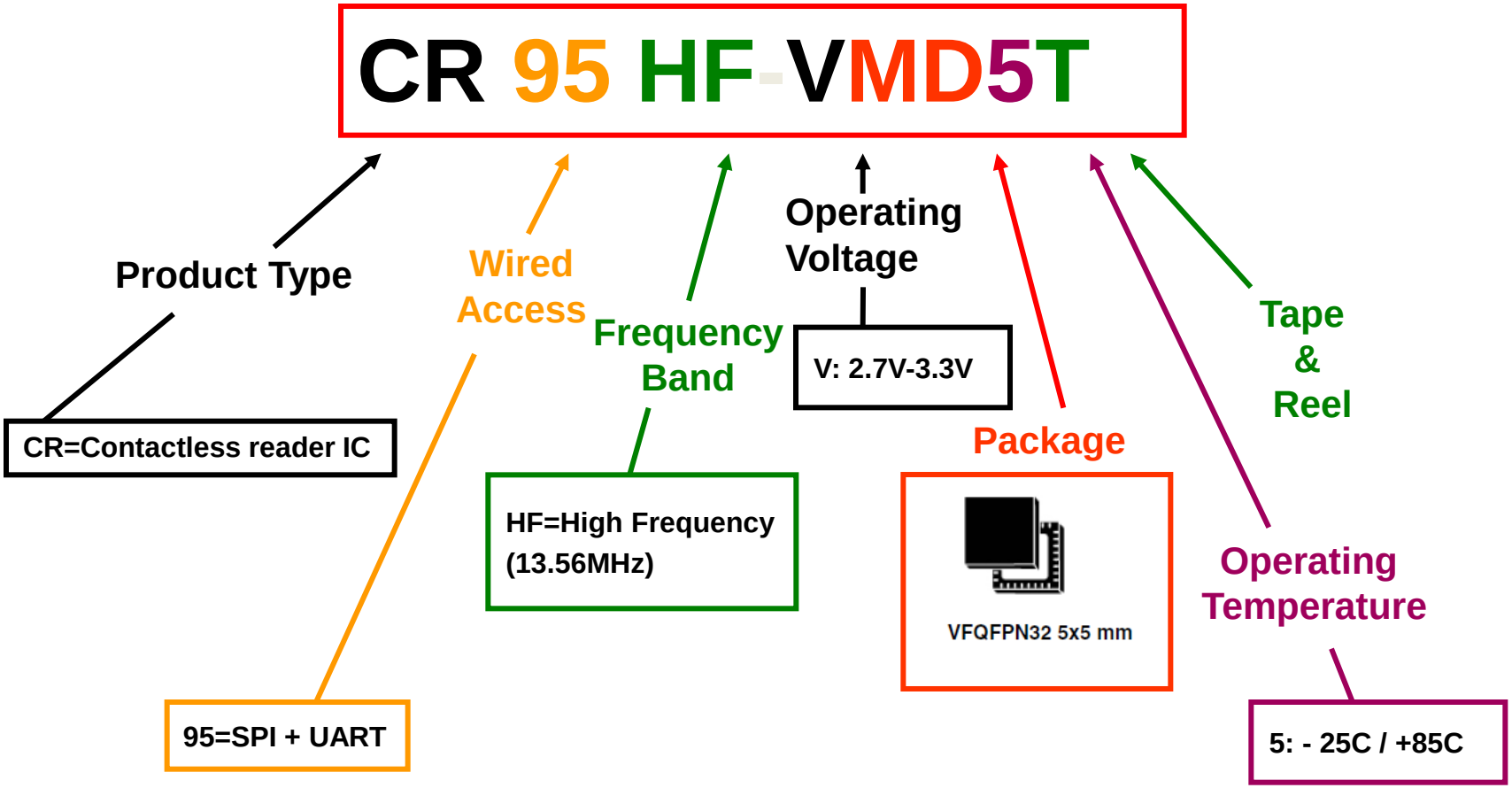
Antenna design guidelines
-Application note AN3394
-Antenna design simplified basic tool

PLUG-CR95HF-B support

- Ideal for application development
- Directly plugs onto your PCB (SPI, UART) or your MCU evaluation board



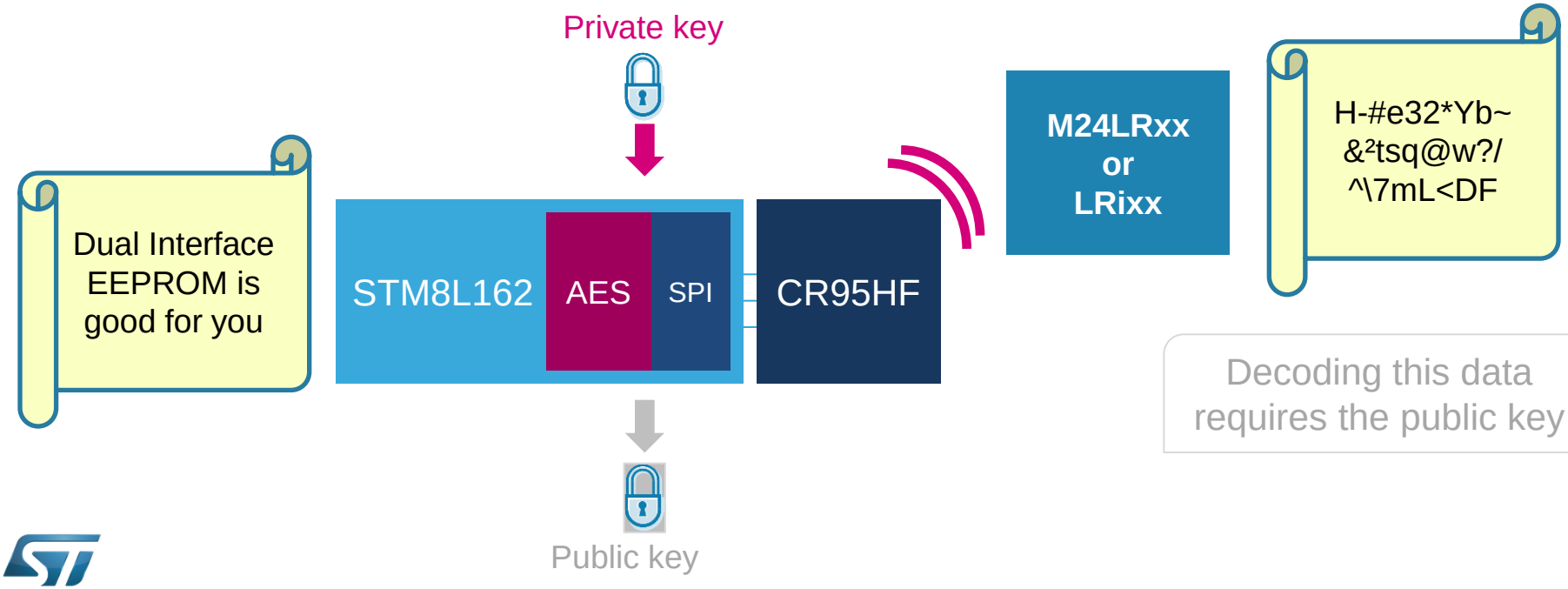
CR95HF ordering information



Encrypting the RF memory's data using AES

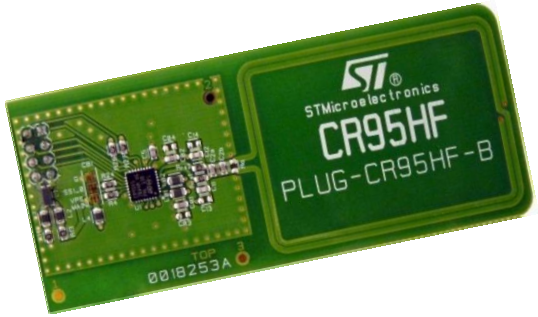
- Why cryptography ?
  - To protect sensitive data
  - Prevent these data to being decoded by unauthorized persons

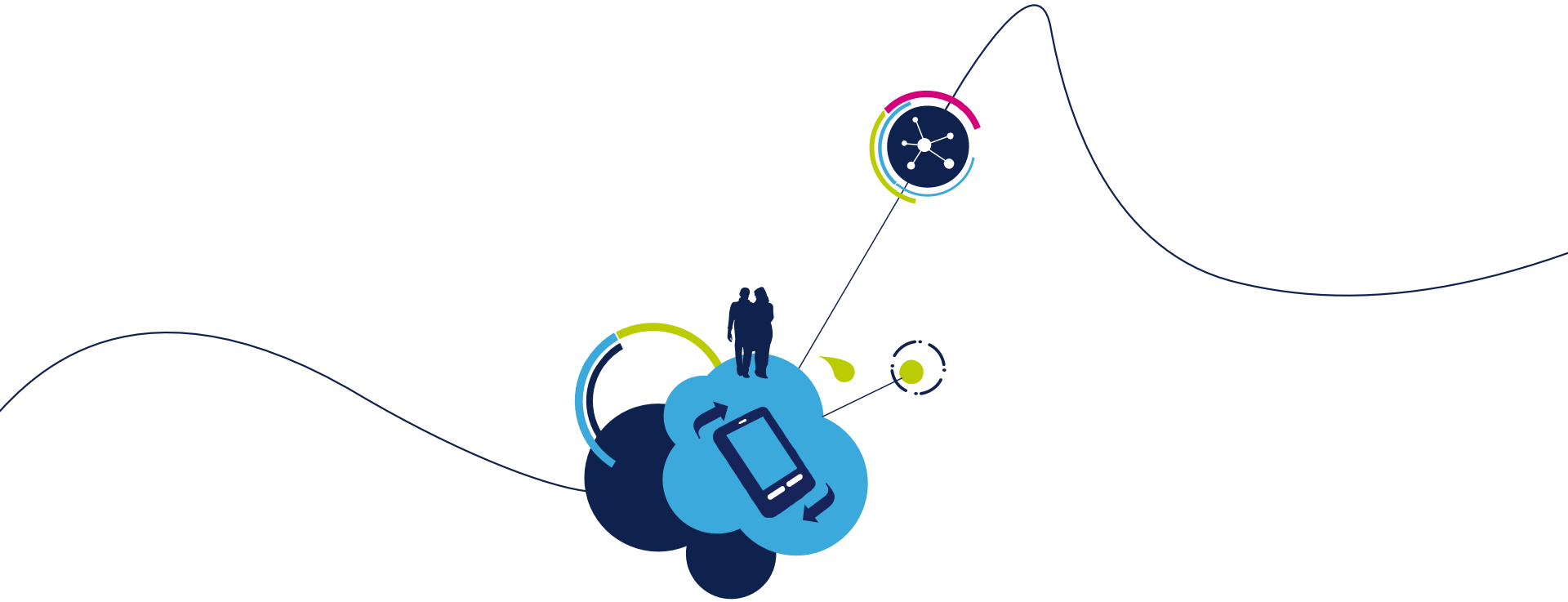
- Reference design overview



Encrypting the RF memory's data using AES

- **Tools :**
  - PLUG-CR95HF-B http://www.st.com/internet/evalboard/product/253308.jsp
  - STM8L1528-EVAL http://www.st.com/internet/evalboard/product/250410.jsp
- **Support available :**
  - AN3992 "Using an STM8L16X AES hardware accelerator with a CR95HF.pdf"
  - STM8L152 firmware ".zip"





M24LRXX + CR95HF Application

DualEE

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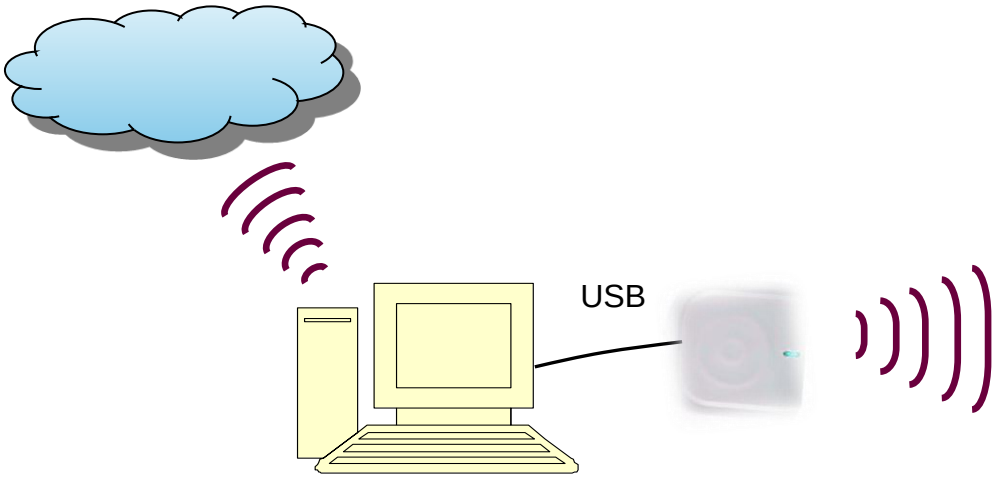
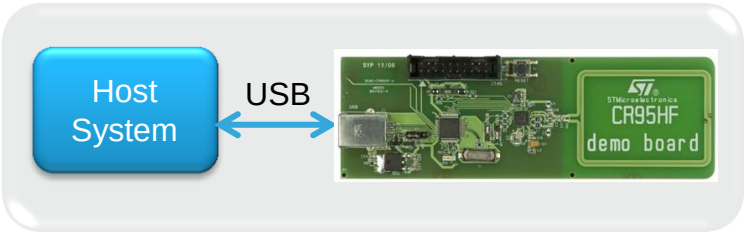
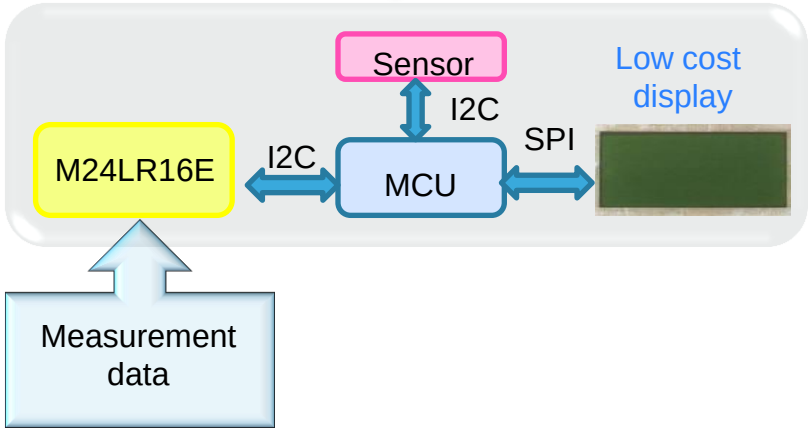
Personal Medical/Healthcare

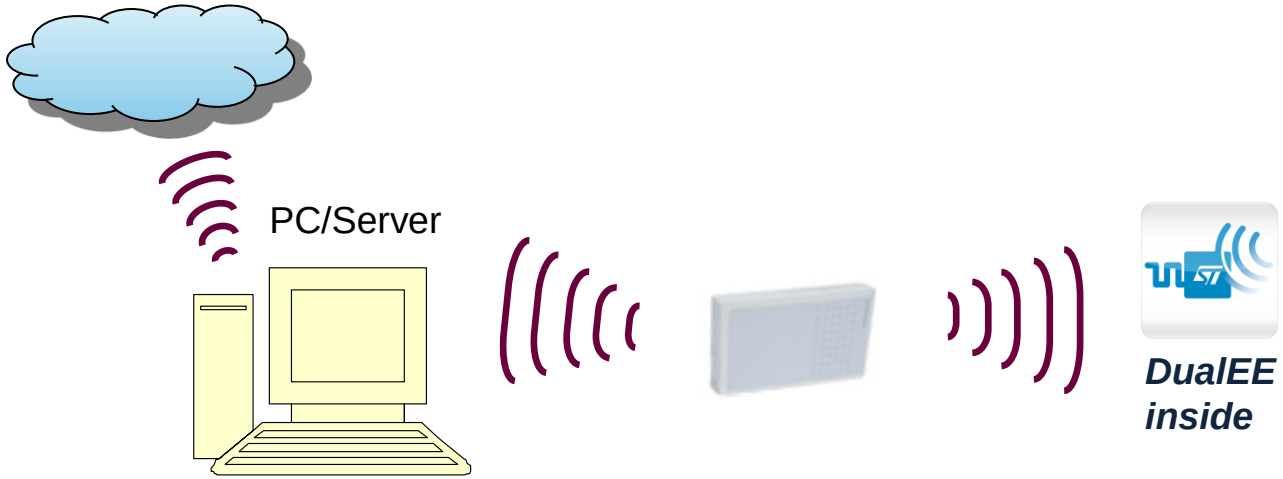


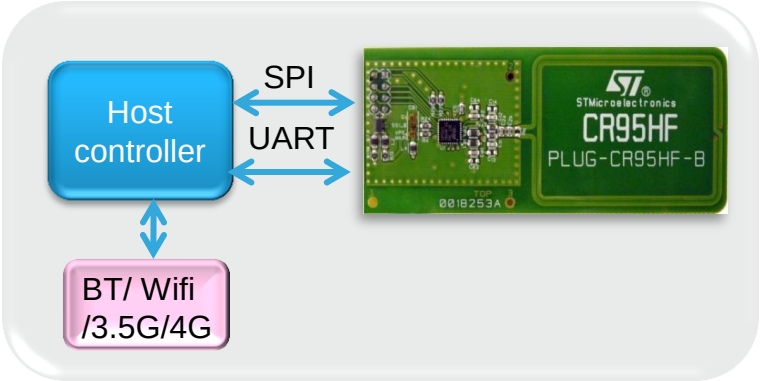


RFID/NFC reader and writer

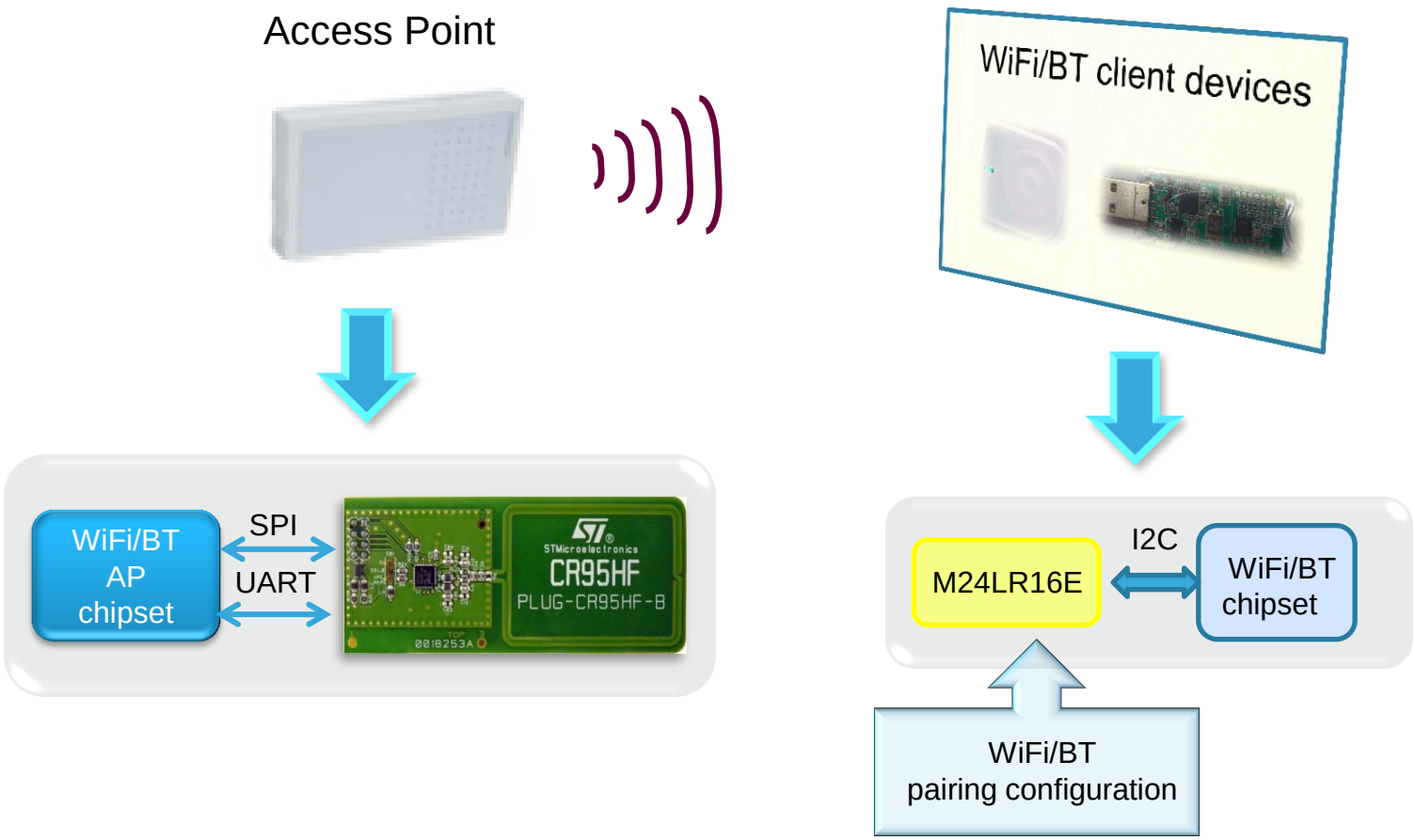


Longer range transmission for Telemedicine/Healthcare





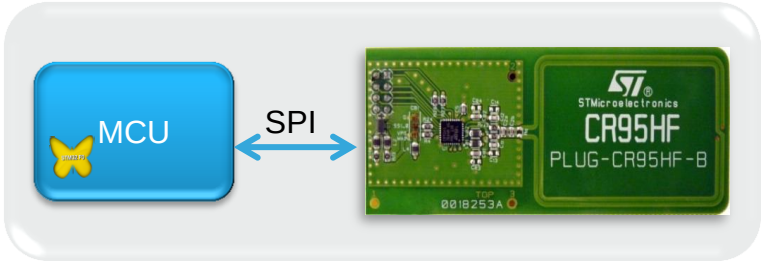
Wireless Pairing on networking devices

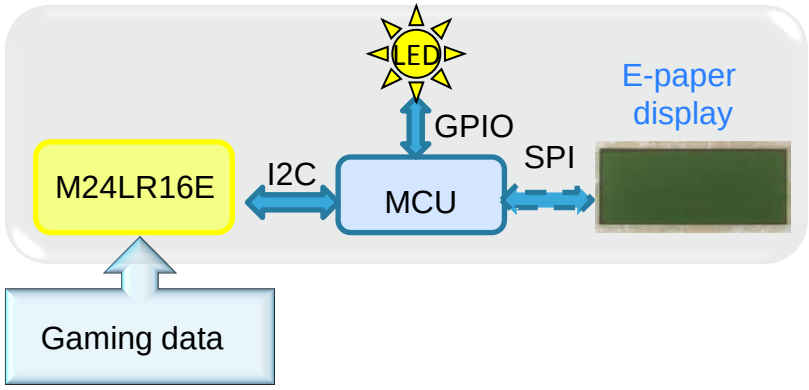


Gaming/Toy

Gaming machine

Display game card





ESL/Datalogger with a PDA

PDA

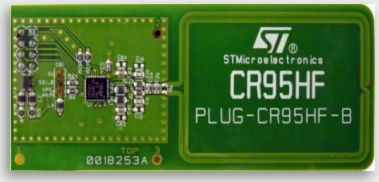
Temperature datalogger

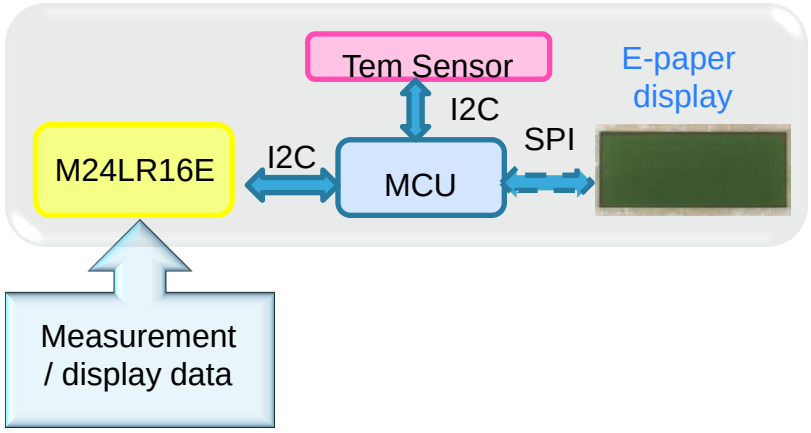
Electronic Shelf labeling

NFC/RFID Reader module

Application processor

UART





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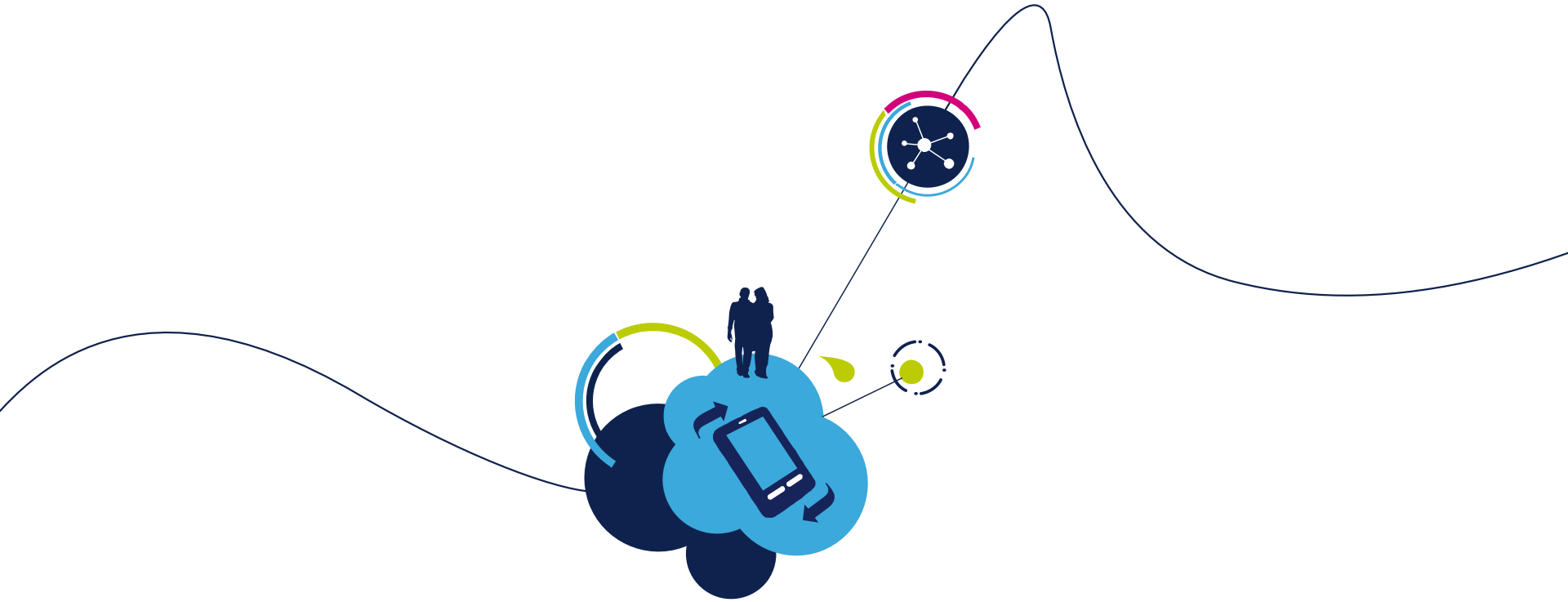

Enjoy the smart life and biz

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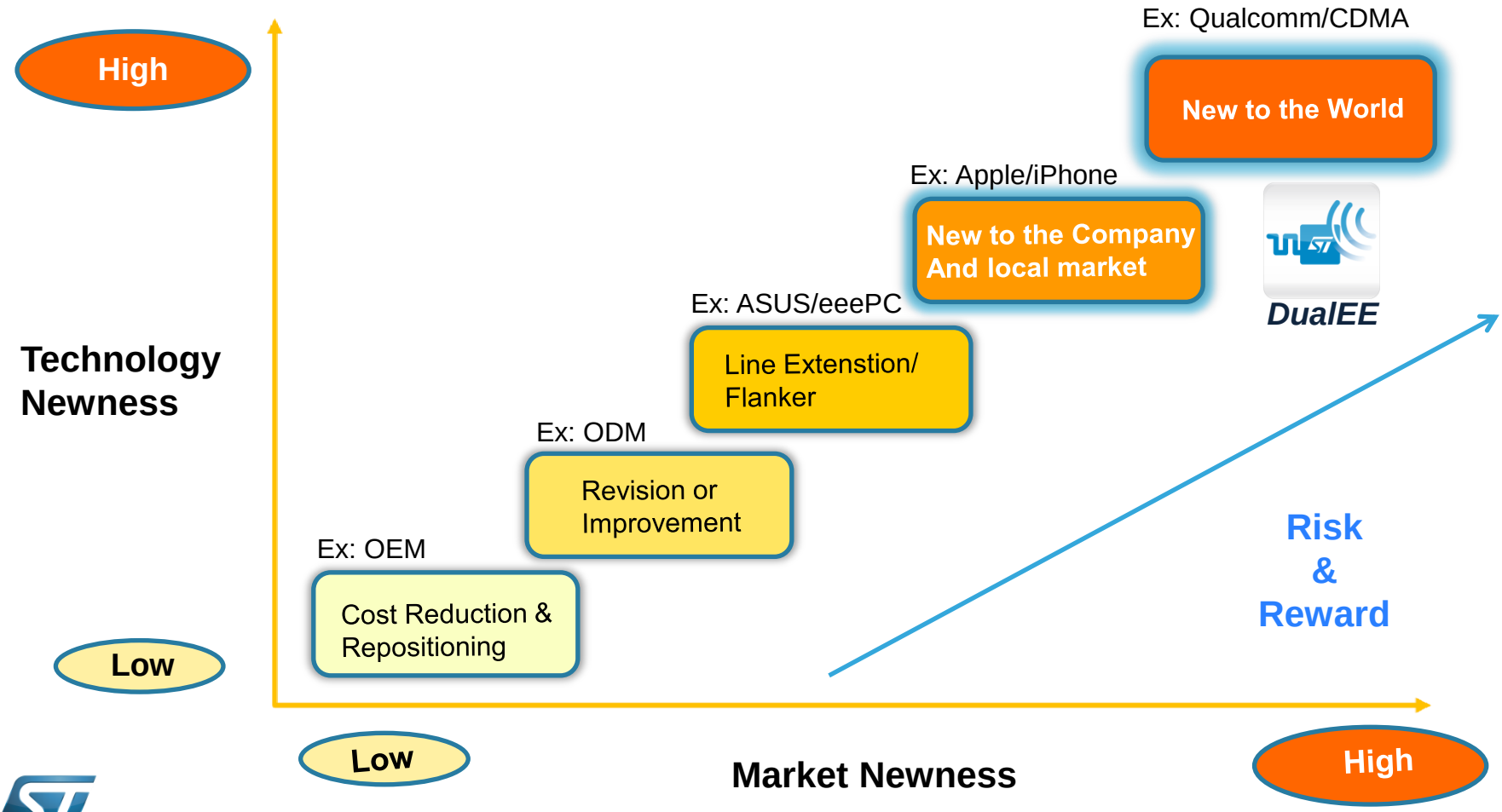
Product/Service Innovation

- Product/service innovation is the result of bringing to life a new way to solve the customer's problem – through a new product or service development – that benefits both the customer and the sponsoring company.



New Smart Life in 21st Century…

Everything is smartly connected!!

Innovation

Opp/Biz

Smart Wardrobe

AIO PC

Smart refrigerator

RFID clothes hanger

Smart grid

Automative

Medical and healthcare

Smart TV

Stay or Reach the goal

Easy to implement a new low power and cost product through ST Dual Interface EEPROM thanks to:

- ***A innovation product based on 2 industry-standard protocols***
- ***Enables cost reduction and flexibility at all product life steps***

Start to develop a new product and augmented service

Increase company Awareness and Improve company image

Move further to reach the goal !

Thank You!

- *For questions or further inquiries, please visit http://www.st.com/internet/mcu/class/1766.jsp*

  or contact kenneth.huang@st.com